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Question Id: 19178

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A 28-year-old woman, gravida 1 para 0, at 16 weeks gestation comes to the office for a prenatal visit. The patient feels well and has no concerns. Medical history is significant for recurrent urinary tract infections. Her only medication is a prenatal multivitamin. Blood pressure is 116/68 mm Hg and pulse is 80/min. Physical examination shows no abnormalities and fetal heart tones are normal. Urine dipstick reveals no blood or leukocyte esterase but is positive for protein. Laboratory testing shows the following:

Serum chemistry	
Sodium	138 mEq/L
Potassium	4.2 mEq/L
Bicarbonate	24 mEq/L
Creatinine	0.6 mg/dL
Glucose	80 mg/dL
Liver function studies	
Albumin	4.5 g/dL

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Glucose

80 mg/dL

Liver function studies

Albumin

4.5 g/dL

Total bilirubin

0.8 mg/dL

Alkaline phosphatase

60 U/L

Aspartate aminotransferase (SGOT) 22 U/L

Alanine aminotransferase (SGPT) 24 U/L

Urinalysis

1+ protein; no cells or casts

A 24-hour urinary protein excretion is 200 mg. Which of the following processes is most likely contributing to this patient's urinary findings?

☐ A. Effacement of podocyte foot processes☐ B. Generalized endothelial dysfunction☐ C. Increased glomerular filtration rate



Alkaline phosphatase

60 U/L

Aspartate aminotransferase (SGOT) 22 U/L

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Urinalysis

1+ protein; no cells or casts

A 24-hour urinary protein excretion is 200 mg. Which of the following processes is most likely contributing to this patient's urinary findings?

- ☐ A. Effacement of podocyte foot processes
- ☐ B. Generalized endothelial dysfunction
- ☐ C. Increased glomerular filtration rate
- ☐ D. Increased mesangial extracellular matrix
- ☐ E. Shedding of injured tubular epithelial cells

Submit



Alkaline phosphatase

60 U/L

Aspartate aminotransferase (SGOT) 22 U/L

Alanine aminotransferase (SGPT) 24 U/L

Urinalysis

1+ protein; no cells or casts

A 24-hour urinary protein excretion is 200 mg. Which of the following processes is most likely contributing to this patient's urinary findings?

- ☐ A. Effacement of podocyte foot processes (16%)
- ☐ B. Generalized endothelial dysfunction (7%)
- ☒ C. Increased glomerular filtration rate (69%)
- ☐ D. Increased mesangial extracellular matrix (3%)
- ☐ E. Shedding of injured tubular epithelial cells (2%)

Correct

69%



01 min, 09 secs



01/10/2021

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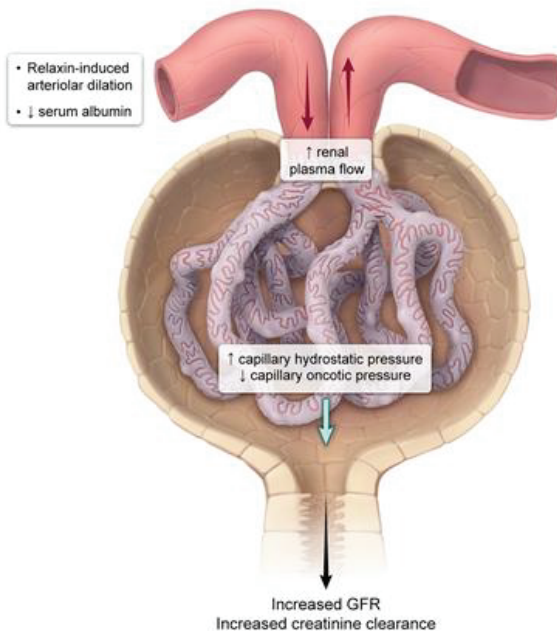
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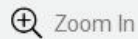
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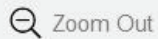
Renal adaptations during pregnancy



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In **pregnancy**, blood volume and cardiac output both increase physiologically due to greater metabolic demands and in preparation for expected blood loss with delivery. As a result, the maternal kidneys experience increased renal blood flow and must process greater volumes of plasma through the glomeruli, leading to **increased glomerular filtration rate** (GFR). During pregnancy, the release of placental hormones also **increases glomerular basement membrane permeability**, which allows for increased leakage of protein into the tubular lumen, and leads to decreased renal tubular protein resorption. These factors, along with increased GFR, contribute to **trace proteinuria** (ie, <300 mg/24 hr), which is a normal finding in pregnancy.

(Choice A) Effacement of podocyte foot processes, which occurs in **minimal change disease**, impairs glomerular filtration and leads to significant proteinuria (eg, 24-hour urinary protein excretion ≥ 300 mg) and potential nephrotic syndrome (eg, rapid-onset edema) due to selective urinary loss of albumin.

(Choice B) Generalized renal endothelial dysfunction is likely the mechanism of renal insufficiency associated with preeclampsia, which typically presents with new-onset hypertension and a 24-hour urinary protein excretion ≥ 300 mg. This patient is normotensive.

(Choice D) The mesangial extracellular matrix is formed by protein (eg, fibronectin, laminin) deposits from





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Calculator



Reverse Color



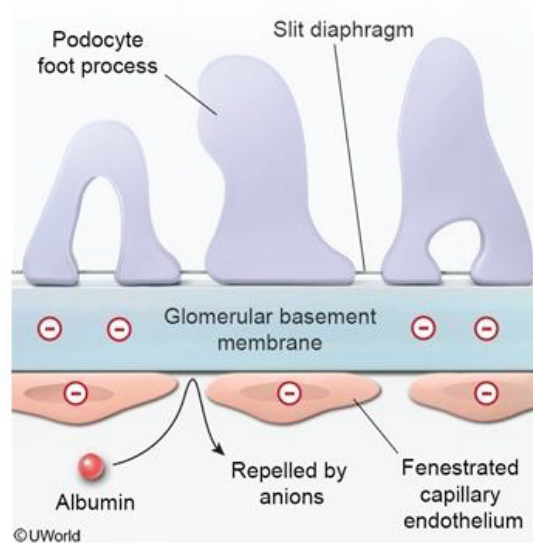
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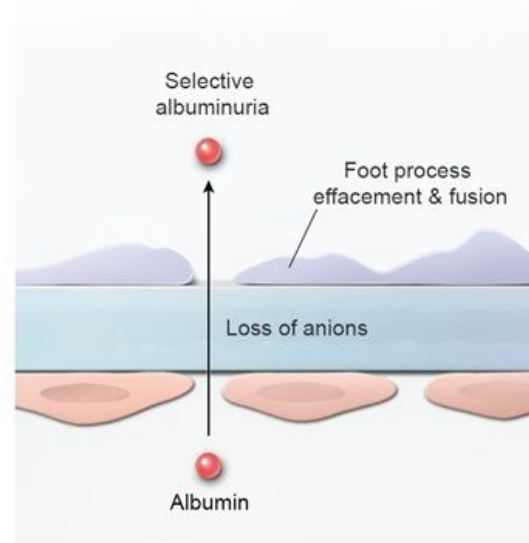
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Normal



Minimal change disease



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End Block



associated with preeclampsia, which typically presents with new-onset hypertension and a 24-hour urinary protein excretion ≥ 300 mg. This patient is normotensive.

(Choice D) The mesangial extracellular matrix is formed by protein (eg, fibronectin, laminin) deposits from glomerular mesangial cells and provides structural support for glomerular capillary loops. Accumulation of extracellular matrix proteins occurs in diabetic nephropathy; however, this patient has no history of diabetes mellitus and has a normal serum glucose level.

(Choice E) Shedding of injured tubular epithelial cells occurs with acute tubular necrosis. Patients typically have elevated creatinine levels and muddy brown casts on urinalysis, which are not seen in this patient.

Educational objective:

Physiologic renal adaptations during pregnancy include increased glomerular filtration rate, greater basement membrane permeability, and decreased tubular resorption of filtered protein. As a result, trace urinary protein excretion (ie, <300 mg/24 hr) is a normal finding in pregnancy.

Physiology

Pregnancy, Childbirth & Puerperium

Normal pregnancy

Subject

System

Topic

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A 32-year-old woman, gravida 2 para 1, at 30 weeks gestation comes to the office for a routine prenatal visit. The patient's pregnancy has been uncomplicated, and she has had no vaginal bleeding or contractions. She has continued to jog daily throughout the pregnancy but is becoming more fatigued by the end of her workouts. The patient has no chronic medical conditions, and her only medication is a daily prenatal vitamin. She does not use tobacco, alcohol, or illicit drugs. Blood pressure is 110/70 mm Hg, pulse is 76/min, and respirations are 20/min. Fetal heart tones are normal. Physical examination is unremarkable. Compared to a nonpregnant state, this patient most likely has which of the following hematologic changes?

	Plasma volume	Red blood cell mass	Hemoglobin concentration
<input type="radio"/> A.	↑	↑	↓
<input type="radio"/> B.	↑	↓	↓
<input type="radio"/> C.	↓	↑	↑
<input type="radio"/> D.	No change	↑	↑



the end of her workouts. The patient has no chronic medical conditions, and her only medication is a daily prenatal vitamin. She does not use tobacco, alcohol, or illicit drugs. Blood pressure is 110/70 mm Hg, pulse is 76/min, and respirations are 20/min. Fetal heart tones are normal. Physical examination is unremarkable. Compared to a nonpregnant state, this patient most likely has which of the following hematologic changes?

	Plasma volume	Red blood cell mass	Hemoglobin concentration
<input type="radio"/> A.	↑	↑	↓
<input type="radio"/> B.	↑	↓	↓
<input type="radio"/> C.	↓	↑	↑
<input type="radio"/> D.	No change	↑	↑
<input type="radio"/> E.	No change	↓	↓

Submit

the end of her workouts. The patient has no chronic medical conditions, and her only medication is a daily prenatal vitamin. She does not use tobacco, alcohol, or illicit drugs. Blood pressure is 110/70 mm Hg, pulse is 76/min, and respirations are 20/min. Fetal heart tones are normal. Physical examination is unremarkable. Compared to a nonpregnant state, this patient most likely has which of the following hematologic changes?

	Plasma volume	Red blood cell mass	Hemoglobin concentration	
<input checked="" type="radio"/> A.	↑	↑	↓	(63%)
<input type="radio"/> B.	↑	↓	↓	(27%)
<input type="radio"/> C.	↓	↑	↑	(2%)
<input type="radio"/> D. No change		↑	↑	(4%)
<input type="radio"/> E. No change		↓	↓	(1%)

Correct

63%

56 secs

10/05/2020

Physiologic changes of pregnancy

Cardiovascular	<ul style="list-style-type: none"> • ↑ Blood volume (plasma > RBC mass) • ↓ Systemic vascular resistance • ↑ Heart rate & cardiac output
Pulmonary	<ul style="list-style-type: none"> • ↑ Central respiratory drive (hyperventilation) • ↓ PaCO₂ (respiratory alkalosis), ↑ PaO₂
Renal	<ul style="list-style-type: none"> • ↑ Renal blood flow & urine output • ↑ GFR, ↓ BUN & serum creatinine • ↑ HCO₃⁻ excretion (metabolic compensation) • ↓ Serum Na⁺ concentration (↑ ADH secretion)
Hematologic	<ul style="list-style-type: none"> • ↑ Prothrombotic coagulation factors • ↓ Hemoglobin concentration (dilutional anemia)

ADH = antidiuretic hormone; **BUN** = blood urea nitrogen; **GFR** = glomerular filtration rate; **RBC** = red blood cell.

During **normal pregnancy**, the maternal hematologic system undergoes several adaptations to



Mark



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Text Zoom



Settings

ADH = antidiuretic hormone; **BUN** = blood urea nitrogen; **GFR** = glomerular filtration rate; **RBC** = red blood cell.

During **normal pregnancy**, the maternal hematologic system undergoes several adaptations to accomodate the developing fetus and placenta. These adaptations include:

- **Increased plasma volume**, which begins at approximately 6 weeks gestation and increases rapidly until term, resulting in a total plasma volume increase of 30%-50% when compared to a nonpregnant state. Increased plasma volume helps reduce positional hypotension caused by uterine compression of the vena cava (ie, decreased venous return when patient is supine or standing) and ensures adequate circulating volume for fetal nutrient delivery and waste removal.
- **Increased maternal red blood cell mass**. Pregnant women generate higher levels of erythropoietin, which drives the production of new red blood cells and increases red blood cell mass by 20%-30%. This increase helps ensure adequate oxygen delivery to the fetus and placenta; it also **protects against excessive blood loss** associated with delivery (eg, postpartum hemorrhage).

Because the expansion of maternal blood plasma volume is greater than the increase in maternal red blood cell mass, pregnant women typically have a **mild reduction in hemoglobin concentration** due to dilution.

Educational objective:





state. Increased plasma volume helps reduce positional hypotension caused by uterine compression of the vena cava (ie, decreased venous return when patient is supine or standing) and ensures adequate circulating volume for fetal nutrient delivery and waste removal.

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Because the expansion of maternal blood plasma volume is greater than the increase in maternal red blood cell mass, pregnant women typically have a **mild reduction in hemoglobin concentration** due to dilution.

Educational objective:

Pregnant patients have marked increases in blood plasma volume (by 30%-50%) and red blood cell mass (by 20%-30%), which helps improve fetal nutrient delivery while also protecting against excessive blood loss during delivery. Because the expansion of blood plasma volume is greater than the increase in red blood cell mass, pregnant women typically have mildly decreased hemoglobin concentrations (ie, dilutional anemia).

References

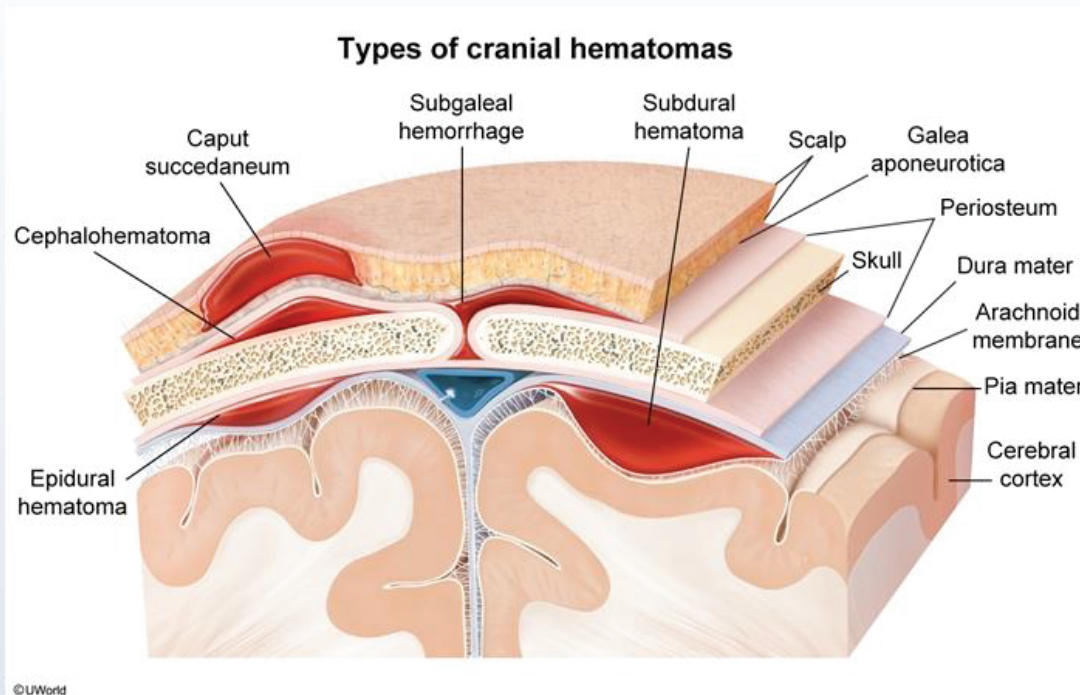




A 10-minute-old boy is being evaluated in the delivery room. The patient was born at term to a 30-year-old primigravida woman. Pregnancy was unremarkable, but labor was complicated by recurrent late decelerations necessitating vacuum assistance for vaginal delivery. Apgar scores were 6 and 8 at 1 and 5 minutes, respectively. Temperature is 37 C (98.6 F), pulse is 170/min, and respirations are 40/min. Scalp examination shows large, fluctuant swelling at the occiput that extends bilaterally to the ears, superiorly toward the crown, and inferiorly into the nape of the neck. This patient's hemorrhage is most likely located between which of the following structures?

- ☐ A. Arachnoid mater and dura mater
- ☐ B. Brain and arachnoid mater
- ☐ C. Dura mater and periosteum
- ☐ D. Periosteum and galea aponeurosis
- ☐ E. Skull and the periosteum

Submit



This newborn has diffuse, fluctuant swelling across the scalp and into the neck, findings concerning for a **subgaleal hemorrhage**.



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This newborn has diffuse, fluctuant swelling across the scalp and into the neck, findings concerning for a **subgaleal hemorrhage**.

Subgaleal hemorrhage is a rare, neonatal extracranial head injury caused by damage to the **emissary veins**, typically from **traction** on the scalp during vacuum-assisted delivery. Shearing of these veins, which connect veins of the scalp to the meningeal veins and dural sinuses, leads to hemorrhage in the potential space between the **periosteum** and **galea aponeurosis** (subgaleal space).

This potential space extends over the whole calvaria and into the neck. Therefore, **massive blood accumulation** (eg, 20%-40% of neonatal blood volume) can occur. Physical examination typically shows **diffuse, fluctuant scalp swelling** that extends **beyond suture lines** and potentially into the neck. The swelling may shift with movement and can continue to expand over 2-3 days. Progressive bleeding can lead to hypovolemia, shock, and death, making prompt recognition critical.

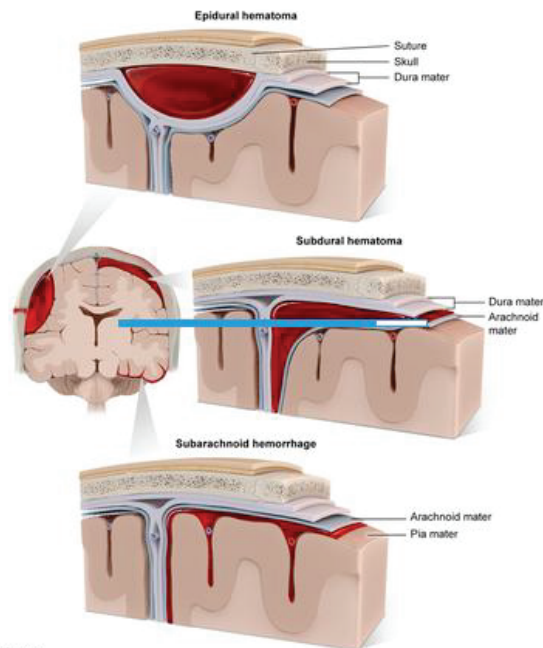
(Choices A, B, and C) Neonatal **intracranial bleeds** are also associated with assisted deliveries.

Subarachnoid hemorrhage develops between the brain and arachnoid mater; subdural hematoma occurs between the arachnoid mater and dura mater; and epidural hematoma occurs between the dura mater and periosteum. Symptomatic intracranial bleeds typically present with seizures or hemodynamic instability, not



Exhibit Display

Types of intracranial hemorrhage



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Subarachnoid hemorrhage develops between the brain and arachnoid mater, subdural hematoma occurs

between the arachnoid mater and dura mater; and epidural hematoma occurs between the dura mater and periosteum. Symptomatic intracranial bleeds typically present with seizures or hemodynamic instability, not diffuse scalp fluctuance.

(Choice E) Bleeding between the skull and periosteum results in a cephalohematoma, which usually presents as a small area of swelling over the parietal or occipital bone. Because the periosteum is fixed at suture lines (eg, sagittal, coronal), the firm, nonfluctuant swelling of a cephalohematoma does not cross suture lines and spread over the calvaria.

Educational objective:

Subgaleal hemorrhage is a potentially fatal neonatal bleed that occurs during delivery when emissary veins between the dural sinuses and scalp are sheared. The accumulation of blood between the periosteum and galea aponeurosis presents with a diffuse, progressive, fluctuant scalp and neck swelling; massive blood loss can lead to shock and death if not promptly recognized.

References

- [Neurological neonatal birth injuries: a literature review.](#)





A healthy, nulliparous 29-year-old woman with regular 28-day cycles comes to the office for a fertility evaluation. Over the past year, she and her 30-year-old husband have been trying to conceive. Her only medications are prenatal vitamins. She tracks her periods, cervical mucus, basal temperature, and intercourse with a smartphone app. The couple has intercourse every other day from cycle day 8 through the LH surge. The patient's urine pregnancy test is positive. The oocyte was most likely arrested in which of the following stages of meiosis immediately prior to fertilization?

- ☐ A. Metaphase of meiosis I
- ☐ B. Metaphase of meiosis II
- ☐ C. Prophase of meiosis I
- ☐ D. Prophase of meiosis II
- ☐ E. Telophase of meiosis I
- ☐ F. Telophase of meiosis II

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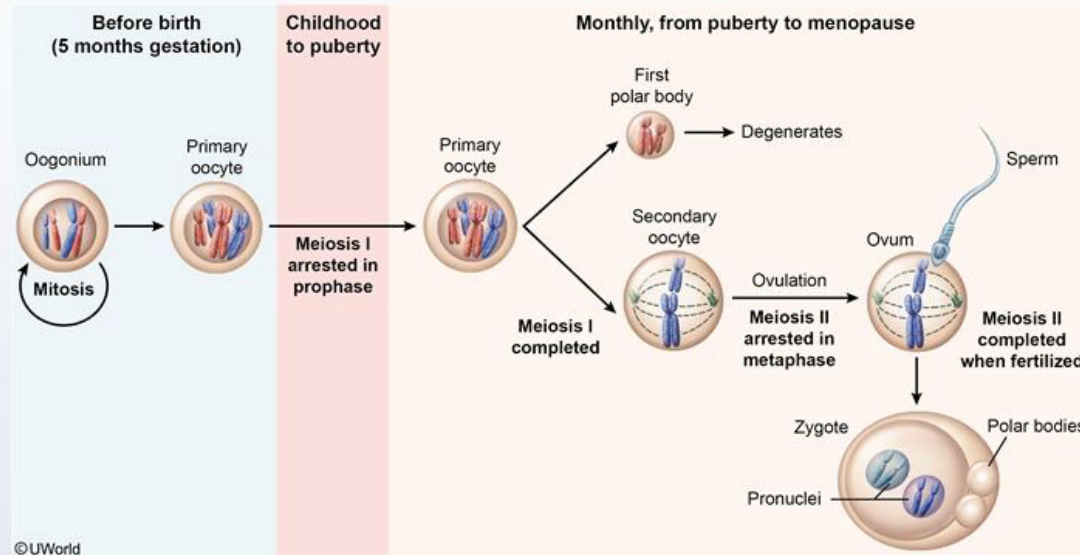
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A healthy, nulliparous 29-year-old woman with regular 28-day cycles comes to the office for a fertility evaluation. Over the past year, she and her 30-year-old husband have been trying to conceive. Her only medications are prenatal vitamins. She tracks her periods, cervical mucus, basal temperature, and intercourse with a smartphone app. The couple has intercourse every other day from cycle day 8 through the LH surge. The patient's urine pregnancy test is positive. The oocyte was most likely arrested in which of the following stages of meiosis immediately prior to fertilization?

- ☐ A. Metaphase of meiosis I (6%)
- ☒ B. Metaphase of meiosis II (62%)
- ☐ C. Prophase of meiosis I (11%)
- ☐ D. Prophase of meiosis II (16%)
- ☐ E. Telophase of meiosis I (1%)
- ☐ F. Telophase of meiosis II (1%)





Female gametogenesis begins in utero at approximately 4 weeks gestation when primordial germ cells migrate from the yolk sac region to the developing gonadal region. These germ cells then differentiate into **oogonia** and multiply by mitosis before beginning meiosis I. Now called **primary oocytes**, these cells arrest in **prophase of meiosis I (Choice C)** and remain there until ovulation. The chromosome pairs are



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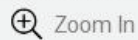
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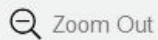
Gametogenesis

Female	Male	Cell cycle stage	# homologs (n)	# chromatids (c)	
Oogonia	Spermatagonia	G0	2n (46)	2c	
Primary oocyte	Primary spermatocyte	Prophase I	2n (46)	4c	
Secondary oocyte	Secondary spermatocyte	Metaphase II	1n (23)	2c	
Mature ovum	Spermatid	Telophase II	1n (23)	1c	

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Female gametogenesis begins in utero at approximately 4 weeks gestation when primordial germ cells migrate from the yolk sac region to the developing gonadal region. These germ cells then differentiate into **oogonia** and multiply by mitosis before beginning meiosis I. Now called **primary oocytes**, these cells arrest in **prophase of meiosis I (Choice C)** and remain there until ovulation. The chromosome pairs are arranged in a tetrad during this phase, and their proximity allows for genetic recombination. The full complement of oocytes is developed by 5 months gestation and then degenerates during the woman's lifetime until depleted at menopause.

At puberty, ovulatory cycles begin and the female is capable of reproduction. During each menstrual cycle, FSH stimulation followed by an LH surge causes some oocytes to resume meiosis I. Telophase I (**Choice E**) is the last phase of meiosis I and yields secondary oocytes and polar bodies. The secondary oocyte begins meiosis II (the polar body degenerates) but halts in metaphase II. Approximately 36 hours after LH levels begin to rise, a secondary oocyte is released from the ovarian follicle. The secondary oocyte remains frozen in **metaphase II until fertilization occurs**, at which point it completes its division (telophase II, **Choice F**) into a mature oocyte (ovum) and second polar body. A normally fertilized embryo is then diploid due to genetic contribution from both the ovum and sperm pronuclei.

(Choice A) Metaphase of meiosis I differs from metaphase of meiosis II and mitosis, as the spindles are





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(telophase II, **Choice F**) into a mature oocyte (ovum) and second polar body. A normally fertilized embryo is then diploid due to genetic contribution from both the ovum and sperm pronuclei.

(Choice A) Metaphase of meiosis I differs from metaphase of meiosis II and mitosis, as the spindles are not preparing to split the centromeres. Instead, the tetrads are lined up along the metaphase plate, and during anaphase the homologs separate from each other with the centromeres intact.

(Choice D) Prophase of meiosis II is unique as it does not immediately follow a period of DNA synthesis; DNA was duplicated prior to prophase of meiosis I.

Educational objective:

Primary oocytes are completely developed in female embryos by the fifth month of gestation, at which point they are arrested in prophase of meiosis I. Normal menstrual cycle hormones stimulate the primary oocyte to resume differentiation. Prior to fertilization, secondary oocytes are arrested in metaphase of meiosis II.

References

- [Oocyte maturation: gamete-somatic cells interactions, meiotic resumption, cytoskeletal dynamics and cytoplasmic reorganization.](#)

Genetics

Pregnancy, Childbirth & Puerperium

Embryologic derivatives

Subject

System

Topic

Block Time Remaining: 00:03:53

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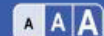
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A 2-day-old girl is in the newborn nursery with persistent crying, tremors, tachypnea, sneezing, and diarrhea. She was born vaginally and had been breastfeeding well until several hours ago when she became tachypneic. Her mother has poorly controlled schizophrenia and did not receive prenatal care. The patient's mother also had a positive hepatitis C antibody test during postnatal laboratory testing. On physical examination, the girl has increased tone in all extremities. She is irritable during examination but quiets when swaddled. Chest radiograph shows normal lung fields. Which of the following is the most appropriate pharmacotherapy for treatment of the newborn's symptoms?

- ☐ A. Flumazenil
- ☐ B. Folic acid
- ☐ C. Methadone
- ☐ D. Naloxone
- ☐ E. Sodium bicarbonate
- ☐ F. Vitamin K





diarrhea. She was born vaginally and had been breastfeeding well until several hours ago when she became tachypneic. Her mother has poorly controlled schizophrenia and did not receive prenatal care. The patient's mother also had a positive hepatitis C antibody test during postnatal laboratory testing. On physical examination, the girl has increased tone in all extremities. She is irritable during examination but quiets when swaddled. Chest radiograph shows normal lung fields. Which of the following is the most appropriate pharmacotherapy for treatment of the newborn's symptoms?

- ☐ A. Flumazenil (11%)
- ☐ B. Folic acid (4%)
- ☒ C. Methadone (44%)
- ☐ D. Naloxone (17%)
- ☐ E. Sodium bicarbonate (12%)
- ☐ F. Vitamin K (8%)

Correct

44%



52 secs



01/21/2021

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Neonatal abstinence syndrome

Pathophysiology	<ul style="list-style-type: none">• Withdrawal from transplacental opiates due to maternal drug use
Clinical manifestations	<ul style="list-style-type: none">• Neurologic: Irritability, hypertonia, jittery movements, seizures (rare)• Gastrointestinal: Diarrhea, vomiting, feeding intolerance• Autonomic: Sweating, sneezing, pupillary dilation
Treatment	<ul style="list-style-type: none">• Opioid therapy (eg, morphine, methadone)

This newborn is showing signs of **neonatal abstinence syndrome (NAS)** due to withdrawal from **opiates**. NAS can result from illicit maternal drug use or prescribed opiate use (ie, a drug treatment program). At-risk newborns include those born to mothers with poor mental health, no prenatal care, and hepatitis C infection, as in this case.

NAS typically presents a variety of manifestations, as shown in the Table. This newborn's crying, tremors, **tachypnea**, sneezing, **irritability**, and **diarrhea** are classic for NAS. Jittery movements are also common in affected newborns. The onset of symptoms depends on the type of opiate(s) used and how recently used by the mother before delivery. Generally, newborns exposed to drugs with shorter half-lives (eg, heroin) are symptomatic at age 1-2 days; those exposed to drugs with longer half-lives (eg, methadone)





heroin) are symptomatic at age 1-2 days; those exposed to drugs with longer half-lives (eg, methadone) may present later.

The treatment of choice for acute opioid withdrawal in neonates is opiate replacement, usually **morphine** or **methadone**. The dose is gradually increased until symptoms are controlled, and then the patient is weaned off over several weeks.

(Choice A) Benzodiazepine toxicity presents primarily with depression of the central nervous system. Flumazenil is a gamma-aminobutyric acid (GABA) receptor antagonist used for benzodiazepine reversal.

(Choice B) Supplementation with folic acid can help prevent neural tube defects during pregnancy.

(Choice D) Naloxone is a pure opioid receptor antagonist. It is used in the setting of acute opioid intoxication or overdose and for diagnosing opioid dependence. Administering naloxone to a patient with opioid withdrawal can result in more severe withdrawal symptoms and potentially cause seizures.

(Choice E) Sodium bicarbonate is used to treat the overdose of tricyclic antidepressants (eg, amitriptyline).

(Choice F) Vitamin K is used primarily as a reversal agent for the anticoagulant warfarin and to prevent hemorrhagic disease of the newborn. It would not help improve this patient's current symptoms.





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(Choice F) Vitamin K is used primarily as a reversal agent for the anticoagulant warfarin and to prevent hemorrhagic disease of the newborn. It would not help improve this patient's current symptoms.

Educational objective:

Neonatal abstinence syndrome presents with neurologic, gastrointestinal, and autonomic symptoms.

Tremors, irritability, diarrhea, and poor feeding are classic findings. Opiate replacement therapy is the treatment of choice; the dose is titrated to the patient's symptoms, and the patient is then slowly weaned.

References

- [Neonatal abstinence syndrome](#)





A 35-year-old woman, gravida 1, para 0, comes to the office to discuss abnormal laboratory results. The patient is at 18 weeks gestation based on her last menstrual period. She drank wine during the first trimester, as she initially did not realize she was pregnant. The patient is otherwise healthy with no medical problems. She takes prenatal vitamins and no other medications. Her immunizations are up-to-date. Results of the quadruple screen performed yesterday are as follows:

Maternal serum	
α -fetoprotein	Low
Unconjugated estriol	Low
β -hCG	High
Inhibin A	High

An ultrasound is scheduled to confirm the patient's gestational age and evaluate for fetal anomalies. Which of the following conditions is the most likely cause of this patient's analyte pattern?

☐ A. Fetal alcohol syndrome





Unconjugated estriol Low

β -hCG High

Inhibin A High

An ultrasound is scheduled to confirm the patient's gestational age and evaluate for fetal anomalies. Which of the following conditions is the most likely cause of this patient's analyte pattern?

- ☐ A. Fetal alcohol syndrome
- ☐ B. Gastroschisis
- ☐ C. Myelomeningocele
- ☐ D. Omphalocele
- ☐ E. Trisomy 21

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Lab Values



Notes



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Settings

Unconjugated estriol Low

β -hCG High

Inhibin A High

An ultrasound is scheduled to confirm the patient's gestational age and evaluate for fetal anomalies. Which of the following conditions is the most likely cause of this patient's analyte pattern?

- ☐ A. Fetal alcohol syndrome (13%)
- ☐ B. Gastroschisis (1%)
- ☐ C. Myelomeningocele (4%)
- ☐ D. Omphalocele (1%)
- ☒ E. Trisomy 21 (78%)

Correct

78%
Answered correctly



01 min, 42 secs
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01/10/2021
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End Block



Maternal serum alpha-fetoprotein screening

↑ MSAFP	↓ MSAFP
<ul style="list-style-type: none">• Open neural tube defects (eg, anencephaly, open spina bifida)• Ventral wall defects (eg, omphalocele, gastroschisis)• Multiple gestation	<ul style="list-style-type: none">• Aneuploidies (eg, trisomy 18 & 21)

MSAFP = maternal serum alpha-fetoprotein.

Down syndrome (DS) is the most common chromosomal abnormality and most common genetic cause of **intellectual disability**. Risk factors include **advanced maternal age (age ≥ 35)** and a parent with a Robertsonian translocation. DS can be screened and diagnosed prenatally. One common option for screening during the second trimester is the **quadruple screen** at 15-18 weeks gestation. **Low maternal serum α -fetoprotein (AFP) and unconjugated estriol** levels are associated with DS and correlate with decreased fetal levels (possibly due to suboptimal fetal tissue function). In addition, **increased β -hCG and inhibin A** are secreted from the placenta, possibly due to compensatory placental hyperfunction. The





inhibin A are secreted from the placenta, possibly due to compensatory placental hyperfunction. The diagnosis is confirmed by karyotyping fetal cells in the amniotic fluid (amniocentesis).

The vast majority of patients with DS have trisomy 21 from **meiotic nondisjunction**, specifically, failure of chromosome 21 to divide during meiosis. Chromosome 21 nondisjunction occurs during **oogenesis** and is significantly associated with advanced maternal age; it is not seen in spermatogenesis or in post-zygotic mitotic errors. DS can also result from an **unbalanced Robertsonian translocation**, during which the entire long arm of one chromosome 21 is translocated to the long arm of an acrocentric chromosome (ie, chromosome 14). These individuals have 46 chromosomes; however, one chromosome 14 is comprised of the long arms of both chromosomes 14 and 21.

(Choice A) Abstinence from alcohol is advised for all pregnant women as the amount that can cause teratogenicity is not known. However, the quadruple test is not used to screen for **fetal alcohol syndrome**.

(Choices B, C, and D) **Omphalocele** and **gastroschisis** cause increased AFP levels in maternal serum and amniotic fluid. High AFP is also associated with multiple gestation and open neural tube defects (eg, myelomeningocele). Neural tube defects are also associated with increased acetylcholinesterase levels in amniotic fluid.

Educational objective:





significantly associated with advanced maternal age; it is not seen in spermatogenesis or in post-zygotic mitotic errors. DS can also result from an **unbalanced Robertsonian translocation**, during which the entire long arm of one chromosome 21 is translocated to the long arm of an acrocentric chromosome (ie, chromosome 14). These individuals have 46 chromosomes; however, one chromosome 14 is comprised of the long arms of both chromosomes 14 and 21.

(Choice A) Abstinence from alcohol is advised for all pregnant women as the amount that can cause teratogenicity is not known. However, the quadruple test is not used to screen for **fetal alcohol syndrome**.

(Choices B, C, and D) **Omphalocele and gastroschisis** cause increased AFP levels in maternal serum and amniotic fluid. High AFP is also associated with multiple gestation and open neural tube defects (eg, myelomeningocele). Neural tube defects are also associated with increased acetylcholinesterase levels in amniotic fluid.

Educational objective:

Down syndrome is the most common chromosomal anomaly. It is associated with low levels of maternal serum α -fetoprotein and estriol and increased levels of β -hCG and inhibin A. Elevated α -fetoprotein levels are seen in multiple gestation, open neural tube defects, and abdominal wall defects.

References





A 19-year-old woman comes to the emergency department with pelvic pain, fever, and chills that began last night. The patient's last menstrual period was 12 weeks ago, and she had a surgical pregnancy termination at a clinic 2 days ago. Two weeks ago, she had fever, chills, a sore throat, and cough and was diagnosed with influenza, which resolved after a few days of rest. The patient's current temperature is 38.3 C (101 F), blood pressure is 92/60 mm Hg, and pulse is 102/min. Physical examination shows diffuse lower abdominal tenderness without any rebound or guarding. Speculum examination reveals an open cervical os, with foul-smelling tissue in the vaginal canal. Bimanual examination reveals moderate uterine tenderness and no adnexal masses. Which of the following is the most likely cause of this patient's condition?

- ☐ A. *Chlamydia trachomatis*
- ☐ B. *Gardnerella vaginalis*
- ☐ C. Influenza A virus
- ☐ D. *Listeria monocytogenes*
- ☐ E. *Staphylococcus aureus*





termination at a clinic 2 days ago. Two weeks ago, she had fever, chills, a sore throat, and cough and was diagnosed with influenza, which resolved after a few days of rest. The patient's current temperature is 38.3 C (101 F), blood pressure is 92/60 mm Hg, and pulse is 102/min. Physical examination shows diffuse lower abdominal tenderness without any rebound or guarding. Speculum examination reveals an open cervical os, with foul-smelling tissue in the vaginal canal. Bimanual examination reveals moderate uterine tenderness and no adnexal masses. Which of the following is the most likely cause of this patient's condition?

- ☐ A. *Chlamydia trachomatis* (18%)
- ☐ B. *Gardnerella vaginalis* (27%)
- ☐ C. Influenza A virus (0%)
- ☐ D. *Listeria monocytogenes* (3%)
- ☒ E. *Staphylococcus aureus* (49%)

Correct



49%

Answered correctly



01 min, 02 secs

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10/31/2020

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Suspend



End Block

Septic abortion

Risk factors	Pregnancy termination with retained products of conception
Microbiology	<ul style="list-style-type: none">• Gram-negative bacilli• <i>Staphylococcus aureus</i>
Clinical presentation	<ul style="list-style-type: none">• Fever, chills, lower abdominal pain, bloody or purulent vaginal discharge• Boggy & tender uterus with dilated cervix• Pelvic ultrasound: Retained products of conception, increased vascularity, echogenic material in the cavity, thick endometrial stripe

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Septic abortion refers to any type of abortion resulting in infected **retained products of conception** in the uterine cavity. In industrialized countries, it is a rare complication of pregnancy termination and may occur with incomplete evacuation of products of conception. Patients with septic abortion typically have fever, abdominal pain, uterine tenderness, and/or a foul-smelling vaginal discharge.

Staphylococcus aureus is a very common pathogen in septic abortion; other causative organisms include

Staphylococcus aureus is a very common pathogen in septic abortion; other causative organisms include gram-negative bacilli (eg, *Escherichia coli*) and group B *Streptococcus*. These organisms are part of normal vaginal flora and seed the uterine cavity during instrumentation, thereafter proliferating in the retained tissue. Most infections associated with septic abortion are confined to the placental tissue, but patients can become septic if toxin-producing bacteria gain access to the intervillous space and bloodstream.

Treatment includes broad-spectrum **antibiotics** and prompt **surgical evacuation** to remove the nidus of infection and prevent severe complications such as sepsis, multi-organ failure, and death. Long-term complications include synechiae (adhesions) in the uterine cavity that can lead to secondary amenorrhea and infertility (**Asherman syndrome**).

(Choice A) *Chlamydia trachomatis* can cause **cervicitis** and pelvic inflammatory disease characterized by pelvic pain with fever and cervical motion tenderness. This pathogen is not typically involved in septic abortion.

(Choice B) *Gardnerella vaginalis* is part of the normal vaginal bacterial flora. An imbalance in the vaginal ecosystem can cause overgrowth of this bacterium, resulting in the characteristic foul-smelling discharge of bacterial vaginosis (BV). Patients with BV do not present with fever or uterine tenderness.



abortion.

(Choice B) *Gardnerella vaginalis* is part of the normal vaginal bacterial flora. An imbalance in the vaginal ecosystem can cause overgrowth of this bacterium, resulting in the characteristic foul-smelling discharge of bacterial vaginosis (BV). Patients with BV do not present with fever or uterine tenderness.

(Choice C) Influenza can cause severe systemic illness with respiratory compromise in pregnant women, but it does not lead to localized intrauterine infection such as septic abortion.

(Choice D) *Listeria monocytogenes* is a foodborne pathogen that is especially virulent in immunocompromised individuals and pregnant women. It is not introduced through uterine instrumentation during pregnancy termination. Infection with this organism can cause miscarriage, chorioamnionitis, and/or neonatal sepsis.

Educational objective:

Septic abortion typically presents with fever, abdominal pain, uterine tenderness, and/or foul-smelling discharge after pregnancy termination. Common offending pathogens include *Staphylococcus aureus* and *Escherichia coli* due to seeding of the uterine cavity during instrumentation.

References

- [Treating spontaneous and induced septic abortions](#)





A 29-year-old woman, gravida 2 para 1, at 32 weeks gestation comes to the emergency department due to heavy vaginal bleeding. The bleeding started an hour ago. It was light initially and associated with only mild abdominal pain, but both the bleeding and the pain have increased, and now the pain is constant and severe. The patient has no chronic medical conditions. Her prior pregnancy was a term vaginal delivery complicated by preeclampsia with severe features. Blood pressure is 156/98 mm Hg, and pulse is 112/min. The uterus is firm and tender. Pelvic examination reveals heavy bleeding from the cervical os. Which of the following is the most likely cause of this patient's current presentation?

- ☐ A. Abnormal invasion of trophoblast into uterine myometrium
- ☐ B. Bleeding placental tissue extending over the cervix
- ☐ C. Physiologic cervical dilation due to spontaneous labor
- ☐ D. Premature separation of the placenta and myometrium
- ☐ E. Rupture of the uterine myometrium and serosa

Submit



A 29-year-old woman, gravida 2 para 1, at 32 weeks gestation comes to the emergency department due to heavy vaginal bleeding. The bleeding started an hour ago. It was light initially and associated with only mild abdominal pain, but both the bleeding and the pain have increased, and now the pain is constant and severe. The patient has no chronic medical conditions. Her prior pregnancy was a term vaginal delivery complicated by preeclampsia with severe features. Blood pressure is 156/98 mm Hg, and pulse is 112/min. The uterus is firm and tender. Pelvic examination reveals heavy bleeding from the cervical os. Which of the following is the most likely cause of this patient's current presentation?

- ☐ A. Abnormal invasion of trophoblast into uterine myometrium (4%)
- ☐ B. Bleeding placental tissue extending over the cervix (9%)
- ☐ C. Physiologic cervical dilation due to spontaneous labor (0%)
- ☒ D. Premature separation of the placenta and myometrium (81%)
- ☐ E. Rupture of the uterine myometrium and serosa (3%)





Abruptio placentae

Definition	<ul style="list-style-type: none">• Premature placental separation from uterus
Risk factors	<ul style="list-style-type: none">• Hypertension, preeclampsia• Abdominal trauma• Cocaine or tobacco use• Prior abruptio placentae
Clinical features	<ul style="list-style-type: none">• Sudden-onset vaginal bleeding• Abdominal pain• High-frequency contractions• Tender, firm uterus

This patient in the third trimester with **painful vaginal bleeding** likely has **abruptio placentae**, the premature separation of the placenta from the myometrium prior to fetal delivery. [Placental abruption](#) occurs when **maternal vessels rupture** at the uteroplacental interface (ie, decidua basalis); the resultant bleeding causes **placental separation** from the uterine myometrium. Blood can also accumulate between





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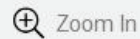
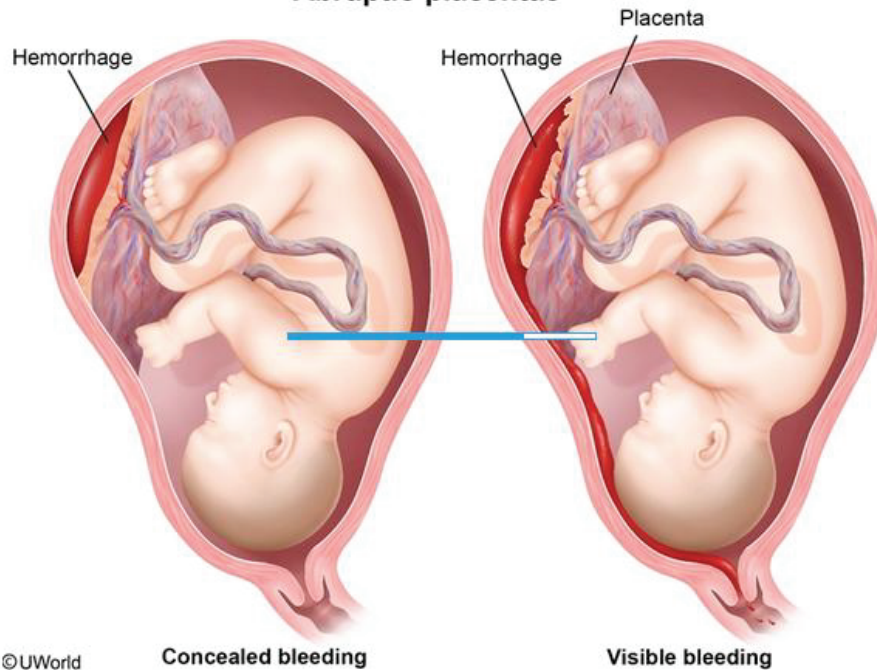
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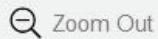
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Abruptio placentae



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bleeding causes placental separation from the uterine myometrium. Blood can also accumulate between the placenta and uterine wall and cause an acute increase in intrauterine pressure, resulting in severe abdominal pain, uterine irritability (ie, high-frequency contractions), and a **tender, firm uterus**.

In this patient, abruptio placentae is likely a complication of **preeclampsia**, a hypertensive disorder of pregnancy that causes widespread **endothelial cell damage**. Endothelial cell dysfunction results in dysregulated vascular tone (eg, hypertension) and **increased vessel fragility**. Preeclampsia also impairs early spiral artery development needed to supply blood to the fetus and placenta. As a result, patients with preeclampsia have abnormally high-resistance spiral arteries that produce low placental perfusion, ischemia, and possible placental infarction, all of which increase the risk of abruptio placentae.

(Choice A) The abnormal invasion of trophoblast into uterine myometrium (eg, **placenta accreta**) can cause heavy vaginal bleeding. However, this disorder is typically diagnosed after fetal delivery when the placenta does not detach from the uterine wall, resulting in postpartum (not antepartum) hemorrhage.

(Choice B) **Placenta previa**, the extension of placental tissue over the cervix, can cause antepartum bleeding. However, placental bleeding from this location can readily exit the uterus via the cervix, so patients typically do not have severe abdominal pain or a firm, tender uterus.

(Choice C) Physiologic cervical dilation (ie, spontaneous labor) can progress from light vaginal bleeding with mild abdominal pain to heavier bleeding during contractions. Labor pain, however, is typically

bleeding causes placental separation from the uterine myometrium. Blood can also accumulate between

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Placenta accreta



Endometrium

Myometrium

Serosa

Normal
deciduaAccreta
(78%)Increta
(17%)Percreta
(5%)

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Zoom In

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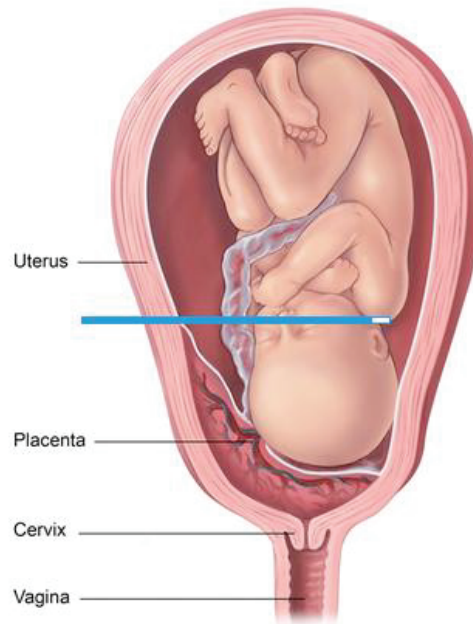
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Exhibit Display

Placenta previa



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(Choice B) **Placenta previa**, the extension of placental tissue over the cervix, can cause antepartum bleeding. However, placental bleeding from this location can readily exit the uterus via the cervix, so patients typically do not have severe abdominal pain or a firm, tender uterus.

(Choice C) Physiologic cervical dilation (ie, spontaneous labor) can progress from light vaginal bleeding with mild abdominal pain to heavier bleeding during contractions. Labor pain, however, is typically intermittent, and the uterus relaxes between contractions.

(Choice E) **Rupture** of the uterine myometrium and serosa can cause abdominal pain and heavy vaginal bleeding. However, in the classic presentation, fetal parts are palpable through the maternal abdominal wall and patients do not have a firm uterus. In addition, this patient has no risk factors (eg, prior cesarean delivery), making this diagnosis less likely.

Educational objective:

Abruptio placentae is caused by rupture of maternal vessels at the uteroplacental interface that leads to premature separation of the placenta from the myometrium. Patients typically have painful vaginal bleeding and a tender, firm uterus. Preeclampsia increases the risk of abruptio placentae.

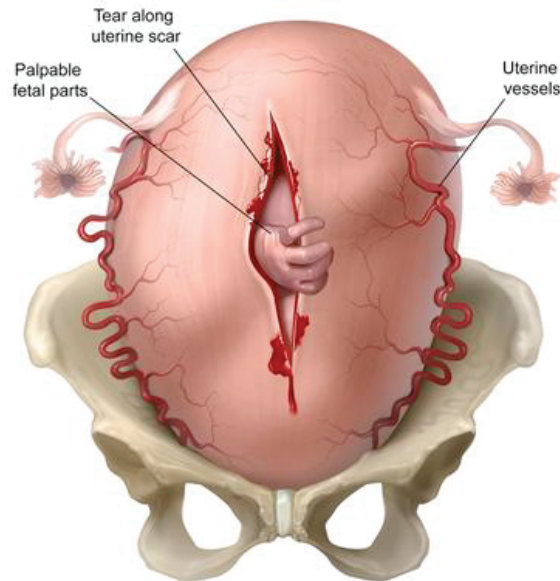
References

- **Placental abruption: epidemiology, risk factors and consequences.**



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Uterine rupture



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A 33-year-old woman, gravida 2 para 1, comes to the office due to a positive home urine pregnancy test. Her last menstrual period was 6 weeks ago, and pelvic ultrasonography confirms an intrauterine pregnancy. The patient has idiopathic pulmonary hypertension complicated by Eisenmenger syndrome. She is aware that pregnancy poses a major mortality risk to herself and the fetus due to the hemodynamic changes of gestation, labor, and delivery. The patient consents to pregnancy termination with a mifepristone and misoprostol regimen. Which of the following is the mechanism of action for mifepristone in this clinical situation?

- ☐ A. Calcium channel blocker
- ☐ B. Cyclooxygenase inhibitor
- ☐ C. Folic acid antagonist
- ☐ D. Oxytocin receptor agonist
- ☐ E. Progesterone antagonist
- ☐ F. Prostaglandin agonist
- ☐ G. Selective estrogen receptor modulator





Her last menstrual period was 6 weeks ago, and pelvic ultrasonography confirms an intrauterine

pregnancy. The patient has idiopathic pulmonary hypertension complicated by Eisenmenger syndrome.

She is aware that pregnancy poses a major mortality risk to herself and the fetus due to the hemodynamic changes of gestation, labor, and delivery. The patient consents to pregnancy termination with a mifepristone and misoprostol regimen. Which of the following is the mechanism of action for mifepristone in this clinical situation?

- ☐ A. Calcium channel blocker (0%)
- ☐ B. Cyclooxygenase inhibitor (1%)
- ☐ C. Folic acid antagonist (3%)
- ☐ D. Oxytocin receptor agonist (10%)
- ☒ E. Progesterone antagonist (67%)
- ☐ F. Prostaglandin agonist (16%)
- ☐ G. Selective estrogen receptor modulator (1%)





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Tutorial



Lab Values



Notes



Calculator



Reverse Color



Text Zoom



Settings

Explanation

Medications used for pregnancy termination**Methotrexate**

- Ectopic pregnancy
- Folic acid antagonist (inhibits dihydrofolate reductase)
- Preferentially destroys proliferating fetal cells

Mifepristone

- Abortion
- Partial progesterone agonist (acts as progesterone antagonist during pregnancy)
- Promotes placental separation & uterine contractions

Misoprostol

- Abortion
- Prostaglandin E1 agonist
- Stimulates uterine contractions

In the second half of the menstrual cycle, progesterone stimulates the development of secretory endometrium to create an environment favorable for implantation. In the first 7 weeks of pregnancy, progesterone is secreted by the corpus luteum; thereafter, its production is assumed by the placenta.

Mifepristone is a progesterone antagonist that binds progesterone receptors with greater affinity than





Mifepristone is a **progesterone antagonist** that binds progesterone receptors with greater affinity than the natural hormone. Progesterone receptor blockade results in apoptosis and **necrosis of the uterine decidua** and prevents further development of a first trimester pregnancy.

When misoprostol is used with mifepristone, pregnancy termination success rate is increased.

Misoprostol, a **prostaglandin E1 analog (Choice F)**, causes cervical softening and uterine contractions leading to expulsion of the pregnancy.

(Choices A and B) Nifedipine (calcium channel blocker) and indomethacin (cyclooxygenase inhibitor) are tocolytic drugs used to stop preterm labor. The decreased intracellular calcium from nifedipine blocks myosin kinase phosphorylation, which in turn leads to myometrial relaxation. Indomethacin stops prostaglandin synthesis, which decreases uterine contractility.

(Choice C) Folic acid antagonists (eg, methotrexate) inhibit trophoblast division, therefore decreasing trophoblast survival, hindering implantation, and encouraging expulsion. Methotrexate is used for the treatment of ectopic pregnancy and for termination of intrauterine pregnancy in conjunction with misoprostol when mifepristone is not available.

(Choice D) Oxytocin is a peptide hormone released by the posterior pituitary that stimulates uterine contractions. Myometrial oxytocin receptor concentration increases at term; therefore, oxytocin has limited





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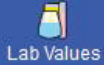
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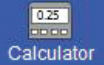
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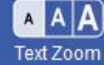
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prostaglandin synthesis, which decreases uterine contractility.

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(Choice D) Oxytocin is a peptide hormone released by the posterior pituitary that stimulates uterine contractions. Myometrial oxytocin receptor concentration increases at term; therefore, oxytocin has limited effects on the uterus in early gestation and does not cause pregnancy termination.

(Choice G) Tamoxifen is a selective estrogen receptor modulator and is used primarily to treat estrogen receptor-positive breast cancer by selective blockade of estrogen-positive cancer cells. Conversely, in the uterus, tamoxifen stimulates endometrial estrogen receptors and can cause endometrial hyperplasia and endometrial adenocarcinoma.

Educational objective:

Progesterone is necessary for implantation and maintenance of pregnancy. Mifepristone is a progesterone antagonist that is used with misoprostol (a prostaglandin-E1 agonist) to terminate a first-trimester pregnancy.



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A 35-year-old Caucasian primigravida is found to have gallstones at 38 weeks of an uncomplicated pregnancy. Ultrasonography performed one year ago failed to demonstrate any abnormalities. Which of the following pathogenetic components most likely contributed to this patient's condition?

- ☐ A. Prolactin-induced phospholipid secretion and progesterone-induced gallbladder hypermotility
- ☐ B. Prolactin-induced sodium secretion into bile and estrogen-induced gallbladder hypomotility
- ☐ C. Progesterone-induced bile acid secretion and hCG-mediated water reabsorption from the bile
- ☐ D. Estrogen-induced bilirubin hypersecretion and cortisol-mediated cholesterol hypersecretion
- ☐ E. Estrogen-induced cholesterol hypersecretion and progesterone-induced gallbladder hypomotility

Submit





A 35-year-old Caucasian primigravida is found to have gallstones at 38 weeks of an uncomplicated pregnancy. Ultrasonography performed one year ago failed to demonstrate any abnormalities. Which of the following pathogenetic components most likely contributed to this patient's condition?

- ☐ A. ~~Prolactin-induced phospholipid secretion and progesterone-induced gallbladder hypermotility (2%)~~
- ☐ B. ~~Prolactin-induced sodium secretion into bile and estrogen-induced gallbladder hypomotility (4%)~~
- ☐ C. ~~Progesterone-induced bile acid secretion and hCG-mediated water reabsorption from the bile (6%)~~
- ☐ D. ~~Estrogen-induced bilirubin hypersecretion and cortisol-mediated cholesterol hypersecretion (9%)~~
- ☒ E. Estrogen-induced cholesterol hypersecretion and progesterone-induced gallbladder hypomotility (76%)

Correct



76%

Answered correctly



33 secs

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Classically, cholelithiasis (gallstone disease) is most common in those who are "fat, fertile, female, and forty." The gallstones are formed by the aggregation of bile constituents and are categorized as cholesterol stones, pigment stones, or mixed stones.

Pregnancy and the usage of oral contraceptives predispose to gallstone formation, with 5-12% of all women developing gallstones during pregnancy. Estrogenic influence increases cholesterol synthesis by upregulating hepatic HMG-CoA reductase activity, which causes the bile to become supersaturated with cholesterol. Progesterone reduces bile acid secretion and slows gallbladder emptying. When the gallbladder is hypomotile or there is more cholesterol than bile salts, the cholesterol precipitates into insoluble crystals that eventually form to make gallstones.

(Choices A, B, C, and D) Cholelithiasis is not secondary to water reabsorption from bile or to the hypersecretion of phospholipids, sodium, bile acids, or bilirubin. Moreover, it is the progesterone-induced gallbladder hypomotility - not hypermotility - that increases the likelihood of developing gallstones.

Educational Objective:

Estrogen-induced cholesterol hypersecretion and progesterone-induced gallbladder hypomotility are responsible for the increased incidence of cholelithiasis in women who are pregnant or using oral contraceptives.





A 41-year-old woman, gravida 0, comes to the office for evaluation of pregnancy. Menarche was at age 12, and her menses recur every 30 days and last 5 days. The patient and her husband have been trying to conceive for the past year and plan intercourse during her fertile window according to the ovulation predictor kit. She has no medical problems, takes no medications, and has no allergies. BMI is 23 kg/m². Vital signs and physical examination are normal. If fertilization and implantation occurred this cycle, when would the β -hCG level first be detectable in the serum?

- ☐ A. 1 day after fertilization
- ☐ B. 3 days after fertilization
- ☐ C. 8 days after fertilization
- ☐ D. 14 days after fertilization
- ☐ E. On the day of fertilization

Submit






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- ☐ A. 1 day after fertilization (2%)
- ☐ B. 3 days after fertilization (11%)
- ☒ C. 8 days after fertilization (70%)
- ☐ D. 14 days after fertilization (14%)
- ☐ E. On the day of fertilization (1%)

Correct

 70%
Answered correctly

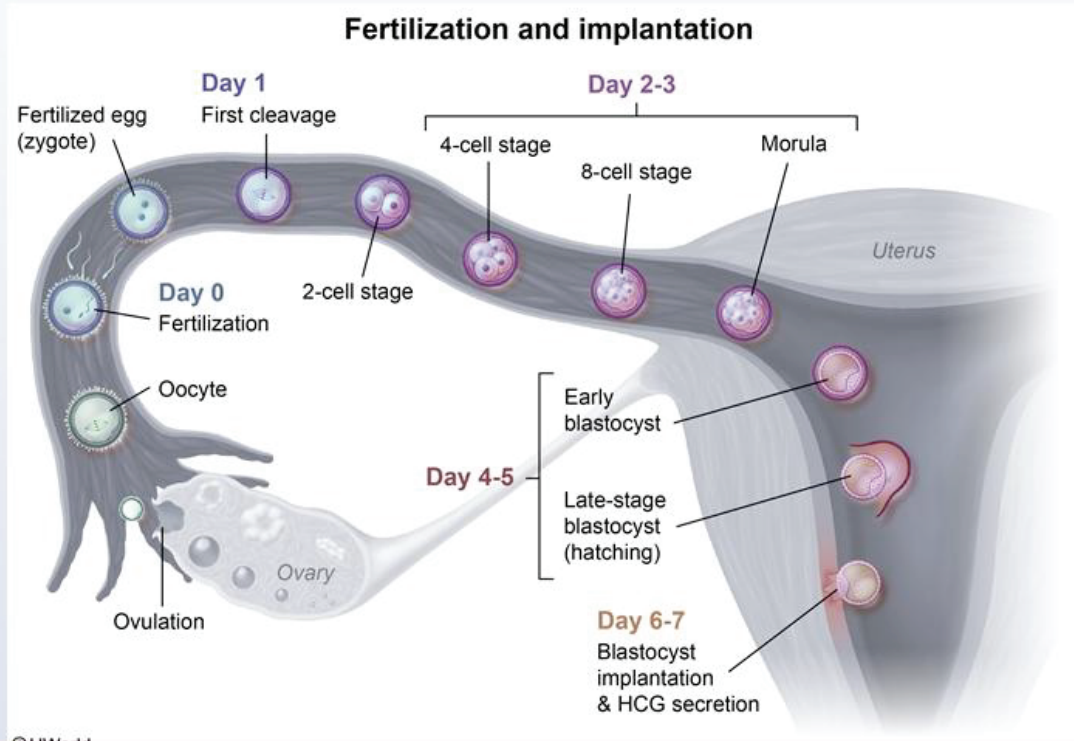
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Explanation





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An ovulation predictor kit measures urinary LH and becomes positive 24 hours before ovulation. Once an oocyte is released from the ovary, sperm may fertilize it for up to 24 hours. After fertilization, the second meiotic division completes and a zygote forms. The zygote travels through the fallopian tube and undergoes mitotic divisions (cleavage), creating smaller cells (blastomeres) that are collectively known as a morula. The morula enters the uterus 3-4 days after fertilization and develops a blastocystic cavity, becoming a blastocyst.

The blastocyst **implants** 6 days after fertilization (**Choices A, B, and E**), and the outer cell mass (trophoblast) differentiates into the cytotrophoblast and **syncytiotrophoblast**. The syncytiotrophoblast invades the endometrial connective tissue 6-7 days after fertilization and starts **secreting β -hCG**, which signals to the corpus luteum in the ovary to continue producing progesterone.

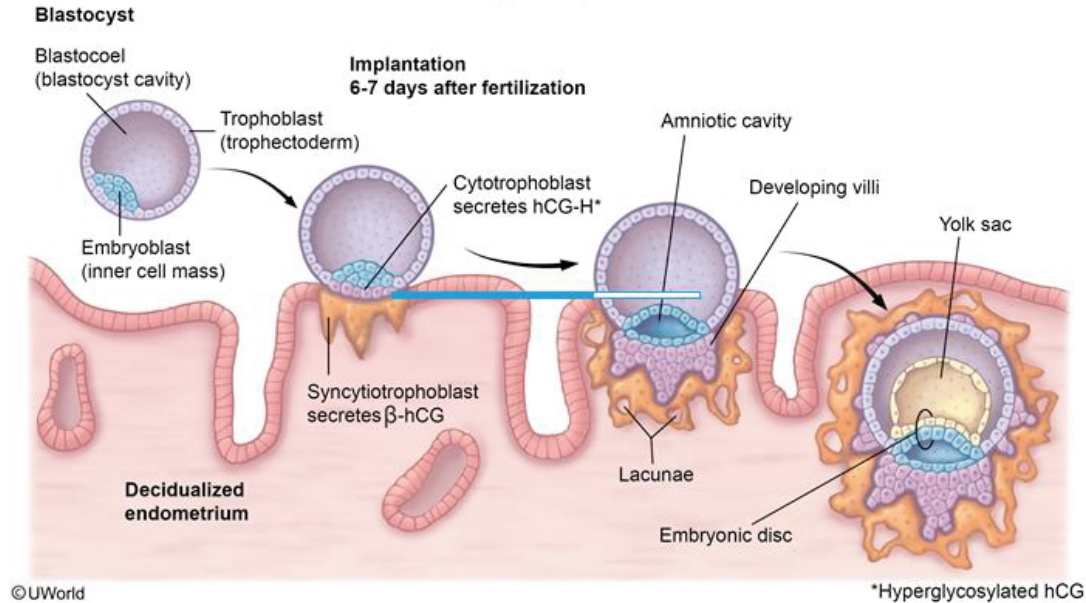
Accordingly, β -hCG may appear in the maternal serum 6 days after fertilization at the earliest and may require additional time to rise to a detectable level in serum (typically **8 days**). β -hCG is detectable in the maternal serum at <5 IU/L, making **serum β -hCG** testing the **most sensitive** method of detecting pregnancy.

(Choice D) A urine pregnancy test is less sensitive than a serum pregnancy test; it becomes positive when



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Blastocyst implantation



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Accordingly, β -hCG may appear in the maternal serum 6 days after fertilization at the earliest and may require additional time to rise to a detectable level in serum (typically **8 days**). β -hCG is detectable in the maternal serum at <5 IU/L, making **serum β -hCG** testing the **most sensitive** method of detecting pregnancy.

(Choice D) A urine pregnancy test is less sensitive than a serum pregnancy test; it becomes positive when β -hCG reaches 20 IU/L, which typically occurs 14 days following fertilization.

Educational objective:

β -hCG is produced by the syncytiotrophoblast after implantation, which generally occurs 6-7 days after fertilization at the earliest. β -hCG typically is detectable in the maternal serum approximately 8 days after fertilization, whereas it is detectable in the urine 14 days after fertilization. Therefore, a serum pregnancy test will be positive before a urine pregnancy test.

References

- [Human chorionic gonadotropin in pregnancy diagnostics.](#)

Embryology

Subject

Pregnancy, Childbirth & Puerperium

System

Normal pregnancy

Topic

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An infant born to a 27-year-old immigrant is evaluated for hearing loss. Physical examination demonstrates white pupils and a continuous machinery murmur over the left infraclavicular area. Which of the following preconception interventions would have most likely prevented this infant's condition?

- ☐ A. Live attenuated vaccine
- ☐ B. Viral component vaccine
- ☒ C. Killed vaccine
- ☐ D. Toxoid vaccine
- ☐ E. Viral enzyme inhibitor drug
- ☐ F. Cellular receptor inhibitor drug
- ☐ G. Interferons
- ☐ H. Prenatal vitamins

Submit



An infant born to a 27-year-old immigrant is evaluated for **hearing loss**. Physical examination demonstrates **white pupils** and a continuous machinery murmur over the left infraclavicular area. Which of the following preconception interventions would have most likely prevented this infant's condition?

- ☒ A. Live attenuated vaccine (57%)
- ☐ B. Viral component vaccine (6%)
- ☐ C. Killed vaccine (16%)
- ☐ D. Toxoid vaccine (4%)
- ☐ E. Viral enzyme inhibitor drug (5%)
- ☐ F. Cellular receptor inhibitor drug (2%)
- ☐ G. Interferons (2%)
- ☐ H. Prenatal vitamins (4%)





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The congenital rubella syndrome is predominantly characterized by neonatal defects of the head (microcephaly, mental retardation), eyes (cataracts), ears (deafness), and heart/cardiovascular system (patent ductus arteriosus, peripheral pulmonic stenosis). The most classic clinical triad of congenital rubella includes congenital cataracts (white pupils), sensory-neural deafness, and patent ductus arteriosus. Live attenuated rubella virus vaccine is currently recommended not only for children at 12-15 months and again at 4-6 years of age, but also in non-pregnant women of childbearing age who lack serum antibody against rubella. At the time of vaccination, women are strongly advised to avoid pregnancy for the next four weeks. This vaccination policy has markedly decreased the incidence of congenital rubella.

(Choices B and C) A viral component or killed vaccine is frequently less effective than a live attenuated vaccine. The viral component or killed vaccines tend to induce only humoral immunity, whereas the live attenuated vaccines induce both humoral and cell-mediated immunity. One risk with the live vaccines is the potential for reversion to virulence. Hepatitis A and rabies vaccines are examples of killed vaccines, whereas measles, mumps, and rubella vaccines are examples of live vaccines.

(Choice D) A toxoid may be prepared by treatment of the toxin with formalin or heat. The toxoid can then induce humoral immunity against the toxin without producing serious toxic effects in the vaccine. Because the pathogenesis of rubella infection is not predominantly mediated by a viral toxin, toxoid is ineffective for



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(Choice D) A toxoid may be prepared by treatment of the toxin with formalin or heat. The toxoid can then induce humoral immunity against the toxin without producing serious toxic effects in the vaccine. Because the pathogenesis of rubella infection is not predominantly mediated by a viral toxin, toxoid is ineffective for this disease.

(Choice E) Reverse transcriptase and protease inhibitors are used for HIV infection.

(Choice F) Enfuvirtide is a fusion inhibitor approved for HIV infection. No drugs are available for the treatment of rubella at this time.

(Choice G) Leukocyte IFN- α is a glycoprotein that inhibits various stages of viral RNA and DNA synthesis. It is currently approved for the treatment of hepatitis B and C virus infection, hairy cell leukemia, condyloma acuminatum, and Kaposi's sarcoma. It is not effective in the treatment of rubella infection.

Educational Objective:

The congenital rubella syndrome is predominantly characterized by neonatal defects of the head (microcephaly, mental retardation), eyes (cataracts), ears (deafness), and heart/cardiovascular system (patent ductus arteriosus, peripheral pulmonic stenosis). To decrease the incidence of this syndrome, the CDC currently recommends the vaccination of children and non-pregnant females of childbearing age with live, attenuated rubella virus vaccine.





A 32-year-old woman at 28 weeks gestation has an ultrasound that shows markedly elevated amniotic fluid levels. She has been feeling short of breath when she is supine but has no other symptoms. The patient has a history of epilepsy that is well-controlled with medication. She lives with her husband who is healthy. The patient does not use tobacco, alcohol, or illicit drugs. Her immunizations are up to date, and she has no allergies. Physical examination shows an abdominal circumference that is larger than expected for gestational age. Which of the following fetal anomalies would most likely account for this patient's polyhydramnios?

- ☐ A. Anencephaly
- ☐ B. Atrial septal defect
- ☐ C. Posterior urethral valves
- ☐ D. Pulmonary hypoplasia
- ☐ E. Renal agenesis
- ☐ F. Spina bifida occulta





levels. She has been feeling short of breath when she is supine but has no other symptoms. The patient has a history of epilepsy that is well-controlled with medication. She lives with her husband who is healthy. The patient does not use tobacco, alcohol, or illicit drugs. Her immunizations are up to date, and she has no allergies. Physical examination shows an abdominal circumference that is larger than expected for gestational age. Which of the following fetal anomalies would most likely account for this patient's polyhydramnios?



- ☒ A. Anencephaly (62%)
- ☐ B. Atrial septal defect (1%)
- ☐ C. Posterior urethral valves (4%)
- ☐ D. Pulmonary hypoplasia (10%)
- ☐ E. Renal agenesis (14%)
- ☐ F. Spina bifida occulta (6%)

Correct

62%



25 secs



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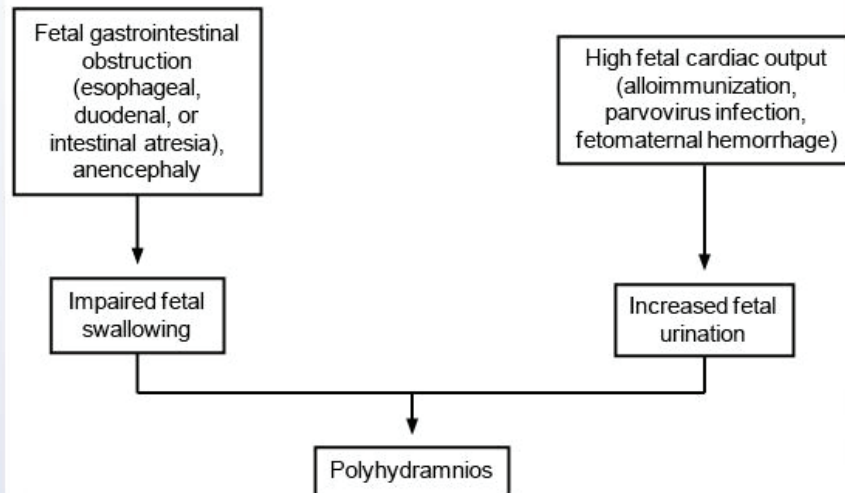
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Explanation

Polyhydramnios



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Polyhydramnios is the excessive accumulation of amniotic fluid. Moderate-to-severe polyhydramnios causes uterine enlargement (eg, increased abdominal circumference) out of proportion to gestational age.

Potential complications include preterm labor, placental abruption, and uterine atony due to uterine



Polyhydramnios is the excessive accumulation of amniotic fluid. Moderate-to-severe polyhydramnios causes uterine enlargement (eg, increased abdominal circumference) out of proportion to gestational age.

Potential complications include preterm labor, placental abruption, and uterine atony due to uterine overdistention. Polyhydramnios also increases the risk of maternal respiratory compromise as the abdominal cavity impairs lung expansion.

Polyhydramnios can be due to decreased fetal swallowing or increased fetal urination. Fetal anomalies associated with **impaired swallowing** include **gastrointestinal obstruction** (eg, duodenal, esophageal, or intestinal atresia) and **anencephaly** (a defect of the cranial neural tube). Causes of **increased fetal urination** include high cardiac output due to anemia or twin-to-twin transfusion syndrome. **Maternal diabetes** and **multiple gestations** tend to cause milder polyhydramnios compared to the aforementioned major fetal anomalies.

This patient's prenatal use of anti-epileptic therapy (eg, valproate, carbamazepine, phenytoin) is a substantial risk factor for fetal neural tube defects such as anencephaly. Like anencephaly, spina bifida **(Choice F)** is a group of neural tube defects (eg, occulta, meningocele, myelomeningocele) that can result from maternal folic acid deficiency and use of folic acid antagonists (anti-epileptic drugs, trimethoprim).

However, spina bifida occulta, the mildest form, is not associated with polyhydramnios as fetal swallowing of amniotic fluid should be normal.





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substantial risk factor for fetal neural tube defects such as anencephaly. Like anencephaly, spina bifida (**Choice F**) is a group of neural tube defects (eg, occulta, meningocele, myelomeningocele) that can result from maternal folic acid deficiency and use of folic acid antagonists (anti-epileptic drugs, trimethoprim). However, spina bifida occulta, the mildest form, is not associated with polyhydramnios as fetal swallowing of amniotic fluid should be normal.

(**Choice B**) Atrial septal defects (ASDs) are one of the most common congenital heart diseases. ASDs are usually asymptomatic in utero. The diagnosis is usually made after birth based on wide fixed splitting of S2 on physical examination. ASDs are not associated with polyhydramnios.

(**Choices C, D, and E**) Renal agenesis is associated with severe oligohydramnios (too little amniotic fluid) after 16 weeks of gestation when the majority of the amniotic fluid is fetal urine. **Posterior urethral valves** in male fetuses can also result in decreased fetal urine output and oligohydramnios. Oligohydramnios, in turn, can lead to fetal compression by the uterus and **Potter sequence**. Pulmonary hypoplasia is a consequence of oligohydramnios and is not associated with polyhydramnios.

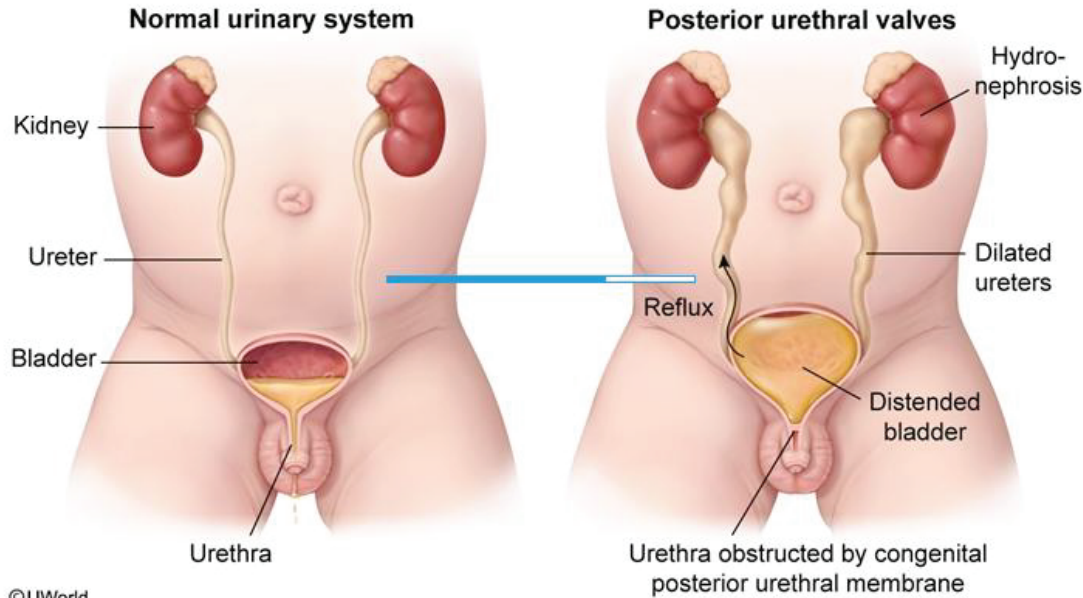
Educational objective:

Polyhydramnios (excessive accumulation of amniotic fluid) presents with increased abdominal circumference out of proportion to gestational age. The etiology is decreased fetal swallowing or increased



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Posterior urethral valves



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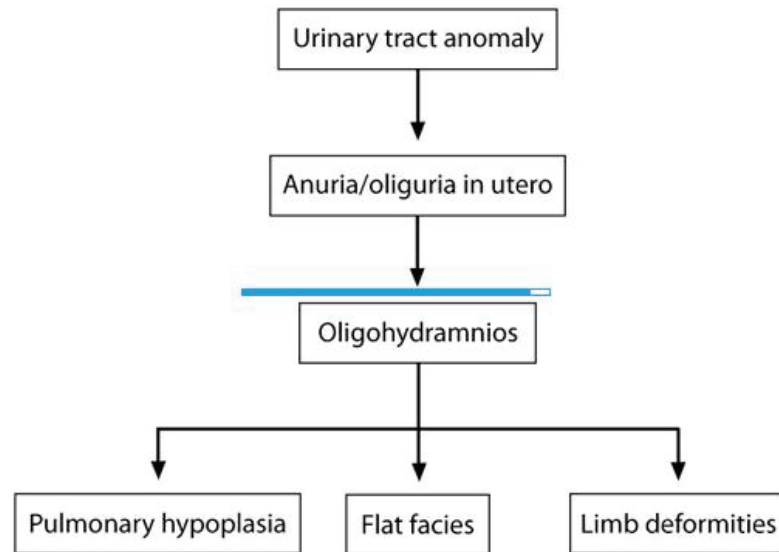
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Potter sequence



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(Choice B) Atrial septal defects (ASDs) are one of the most common congenital heart diseases. ASDs are usually asymptomatic in utero. The diagnosis is usually made after birth based on wide fixed splitting of S2 on physical examination. ASDs are not associated with polyhydramnios.

(Choices C, D, and E) Renal agenesis is associated with severe oligohydramnios (too little amniotic fluid) after 16 weeks of gestation when the majority of the amniotic fluid is fetal urine. Posterior urethral valves in male fetuses can also result in decreased fetal urine output and oligohydramnios. Oligohydramnios, in turn, can lead to fetal compression by the uterus and Potter sequence. Pulmonary hypoplasia is a consequence of oligohydramnios and is not associated with polyhydramnios.

Educational objective:

Polyhydramnios (excessive accumulation of amniotic fluid) presents with increased abdominal circumference out of proportion to gestational age. The etiology is decreased fetal swallowing or increased fetal urination. Fetal anomalies associated with impaired swallowing include gastrointestinal obstruction (eg, duodenal, esophageal, or intestinal atresia) and anencephaly.

References

- Polyhydramnios: a warning sign in the prenatal ultrasound diagnosis of foetal malformation?
- Intrauterine exposure to carbamazepine and specific congenital malformations: systematic review and



A 16-year-old girl comes to the emergency department with vaginal bleeding. Her last menstrual period was 12 weeks ago. She is sexually active and does not use contraception. The patient had a miscarriage last year that required a dilation and curettage. Urine pregnancy test is positive. Transvaginal ultrasound demonstrates an intrauterine gestational sac without fetal cardiac activity, and a dilation and curettage is performed. Pathology shows fetal tissue, focal trophoblastic hyperplasia, and some enlarged villi interspersed with normal villi. Which of the following is the most likely diagnosis?

- ☐ A. Choriocarcinoma
- ☐ B. Complete mole
- ☐ C. Invasive mole
- ☐ D. Miscarriage
- ☐ E. Partial mole
- ☐ F. Placental site trophoblastic tumor

Submit



A 16-year-old girl comes to the emergency department with vaginal bleeding. Her last menstrual period was 12 weeks ago. She is sexually active and does not use contraception. The patient had a miscarriage last year that required a dilation and curettage. Urine pregnancy test is positive. Transvaginal ultrasound demonstrates an intrauterine gestational sac without fetal cardiac activity, and a dilation and curettage is performed. Pathology shows fetal tissue, focal trophoblastic hyperplasia, and some enlarged villi interspersed with normal villi. Which of the following is the most likely diagnosis?

- ☐ A. Choriocarcinoma (2%)
- ☐ B. Complete mole (8%)
- ☐ C. Invasive mole (1%)
- ☐ D. Miscarriage (5%)
- ☒ E. Partial mole (81%)
- ☐ F. Placental site trophoblastic tumor (1%)





Histology of gestational trophoblastic disease

Diagnosis	Classification	Trophoblasts	Villi	Fetal/ embryonic tissue
Partial mole	Benign	Focally hyperplastic	Focally enlarged, hydropic	Present, triploid
Complete mole	Benign	Diffusely hyperplastic	Diffusely enlarged, hydropic	Absent
Invasive mole	Malignant	Diffusely hyperplastic with myometrial invasion	Diffusely enlarged, hydropic	Absent
Gestational choriocarcinoma	Malignant	Diffusely anaplastic/ necrotic with vascular invasion	Absent	Present or absent





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A hydatidiform mole is a premalignant gestational trophoblastic disease (GTD) characterized by abnormal placental trophoblastic proliferation, resulting in **markedly elevated β -hCG** levels. Molar pregnancies are benign and result from aberrant fertilization and **overexpression of paternal genes**. Risk factors include extremes of maternal age, prior molar pregnancy, and prior miscarriage.

This patient has a **partial hydatidiform mole**, which typically presents in early pregnancy with **vaginal bleeding** and no fetal cardiac activity, similar to a miscarriage. Partial moles have a **triploid karyotype (69,XXX or XXY)** containing maternal and paternal DNA, with an extra chromosome set of paternal origin. Evacuated uterine contents contain **fetal tissue** and other parts (eg, cord, amniotic membrane), some edematous villi with **focal trophoblastic proliferation**, and some normal-appearing villi.

A complete mole (**Choice B**) may also present with vaginal bleeding. In addition, the uterus is enlarged out of proportion to the gestational age, and a **snowstorm pattern** is pathognomonic. Pre-eclampsia, hyperthyroidism, hyperemesis, and theca-lutein cysts may be present. Cells of the evacuated tissue have a 46,XX (or rarely 46,XY) karyotype with only paternal DNA. Histologically, no fetal tissue is present, and only edematous villi are seen.

(**Choice A**) Choriocarcinoma is a malignant GTD that can develop after any pregnancy. It often presents





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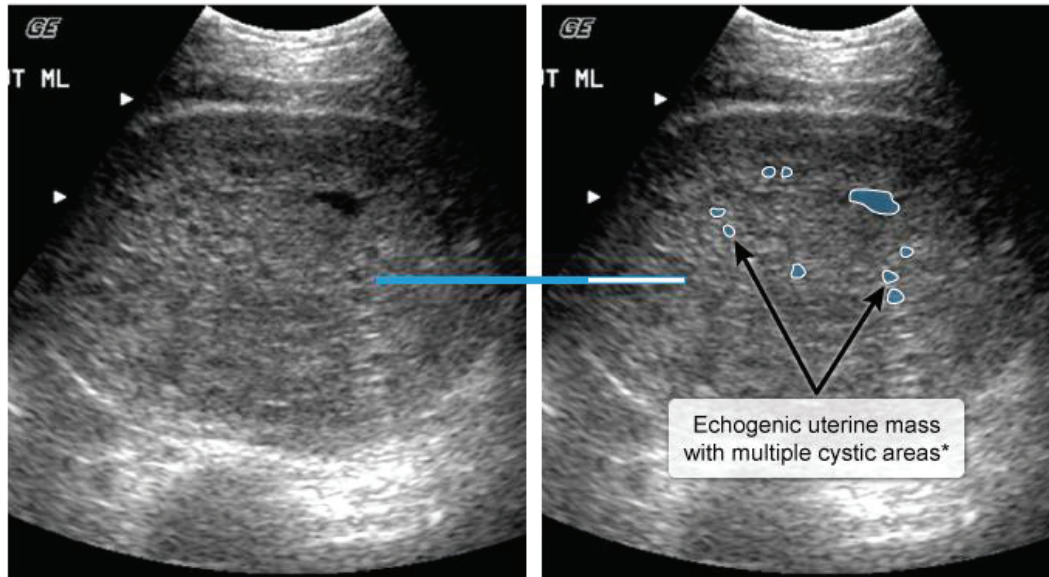
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Complete hydatidiform mole



**"Snowstorm" appearance

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(Choice A) Choriocarcinoma is a malignant GTD that can develop after any pregnancy. It often presents

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(Choice A) Choriocarcinoma is a malignant GTD that can develop after any pregnancy. It often presents with vaginal bleeding and pulmonary metastases. Pathology shows sheets of anaplastic cytotrophoblasts and syncytiotrophoblasts and no villi.

(Choice C) An invasive mole is diagnosed by histologic evidence of villi invading the myometrium on a hysterectomy specimen. This can be the malignant progression of a complete mole.

(Choice D) A miscarriage is a pregnancy loss prior to 20 weeks gestation and presents with vaginal bleeding and low β -hCG level. Pathology would show fetal tissue and normal villi and trophoblastic tissue.

(Choice F) A placental site trophoblastic tumor is a proliferation of intermediate trophoblasts. This malignant type of GTD produces human placental lactogen.

Educational objective:

A partial mole will have a triploid karyotype (eg, 69,XXX or XXY) and contain fetal tissue with some edematous villi with focal trophoblastic proliferation, and normal-appearing villi. Patients present with vaginal bleeding, and prior miscarriage is a risk factor.

References

- [Gestational trophoblastic disorders: an update in 2015.](#)





A 21-day-old boy is brought to the office by his mother because of a palpable bulge in the child's neck. He continues to feed well but appears comfortable only when held with his body sideways under the breast. He is at the 50th percentile for height, weight, and head circumference. The child favors looking toward the right and cries when his head is turned to the left. There is a firm mass on the left side of his neck that does not move when the child swallows. The remainder of the examination is unremarkable. Which of the following conditions was most likely present prenatally?

- ☐ A. Folate deficiency
- ☐ B. Intrauterine malposition
- ☐ C. Defective fetal collagen synthesis
- ☐ D. Maternal alcohol consumption
- ☐ E. Upper respiratory infection in the mother

Submit



A 21-day-old boy is brought to the office by his mother because of a palpable bulge in the child's neck. He continues to feed well but appears comfortable only when held with his body sideways under the breast. He is at the 50th percentile for height, weight, and head circumference. The child favors looking toward the right and cries when his head is turned to the left. There is a firm mass on the left side of his neck that does not move when the child swallows. The remainder of the examination is unremarkable. Which of the following conditions was most likely present prenatally?

- ☐ A. Folate deficiency (12%)
- ☒ B. Intrauterine malposition (47%)
- ☐ C. Defective fetal collagen synthesis (15%)
- ☐ D. Maternal alcohol consumption (9%)
- ☐ E. Upper respiratory infection in the mother (13%)

Correct



47%
Answered correctly



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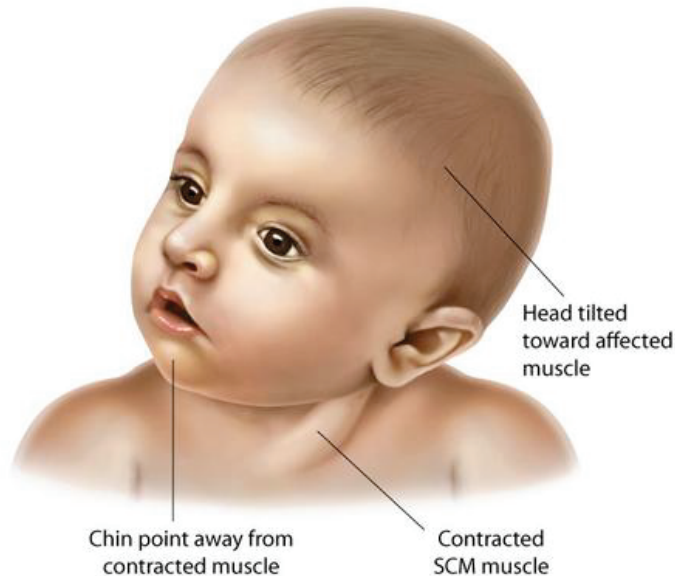
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Congenital torticollis



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This infant has **congenital torticollis**, which typically develops by 2 to 4 weeks of age. It is most commonly caused by **birth trauma** (eg, breech delivery) or **malposition** of the head in utero (eg, due to fetal macrosomia or oligohydramnios), both of which can result in **sternocleidomastoid muscle (SCM) injury** and fibrosis. Children with congenital torticollis may have additional musculoskeletal anomalies, including hip dysplasia, metatarsus adductus (ie, adduction of the forefoot), and talipes equinovarus (ie, clubfoot).

The diagnosis of congenital torticollis is made clinically. On physical examination, the **head is tilted toward** the affected side with the **chin pointed away** from the contracture. A soft-tissue **mass** may be palpable in the inferior one-third of the affected SCM. Plagiocephaly and facial asymmetry may be seen in severe cases. Most cases resolve with conservative therapy and stretching exercises.

(Choice A) Folate deficiency during the first trimester of pregnancy is associated with fetal neural tube defects (eg, spina bifida).

(Choice C) Defective collagen synthesis causes osteogenesis imperfecta (brittle bone disease). Patients with the lethal variety usually die in utero or in early infancy due to severe fractures, pulmonary failure, or intracerebral hemorrhage.





(Choice C) Defective collagen synthesis causes osteogenesis imperfecta (brittle bone disease). Patients with the lethal variety usually die in utero or in early infancy due to severe fractures, pulmonary failure, or intracerebral hemorrhage.

(Choice D) Alcohol consumption during pregnancy can cause fetal alcohol syndrome. Affected infants have poor growth, functional developmental deficits, and characteristic facial abnormalities including a smooth philtrum, thin vermilion border, and small palpebral fissures.

(Choice E) The majority of upper respiratory infections in pregnancy are benign. However, rubella, one of the TORCH infections, is transmitted by the respiratory route and can cause severe birth defects, including hearing loss, cataracts, and congenital heart defects.

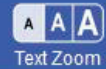
Educational objective:

Congenital torticollis is typically noted by 2 to 4 weeks of age, after which the child prefers to hold the head tilted to one side. It is most commonly the result of malposition of the head in utero or birth trauma. Most cases resolve with conservative therapy and stretching exercises.

References

- [Torticollis in infants and children: common and unusual causes.](#)





A 36-year-old woman, gravida 2 para 1, at 38 weeks gestation comes to the hospital in active labor, dilated to 10 cm. She has received no prenatal care this pregnancy. Her prior pregnancy resulted in an uncomplicated cesarean delivery. On admission, temperature is 36.7 C (98.1 F), blood pressure is 132/84 mm Hg, and pulse is 94/min. The patient precipitously delivers an infant weighing 4.1 kg (9 lb 2 oz). After delivery of the infant, small placental fragments are removed in pieces via manual extraction. Profuse vaginal bleeding occurs, and intravenous lines are placed. Uterotonic medications are administered and vigorous uterine massage is performed. The uterine fundus is firm, but the bleeding continues. Which of the following is the most likely cause of this patient's ongoing vaginal bleeding?

- ☐ A. Full-thickness rupture of the uterine myometrium
- ☐ B. Hypertension-induced placental detachment
- ☐ C. Inadequate uterine contraction
- ☐ D. Infection of the uterus and placental membranes
- ☐ E. Placental invasion into the uterine myometrium





to 10 cm. She has received no prenatal care this pregnancy. Her prior pregnancy resulted in an uncomplicated cesarean delivery. On admission, temperature is 36.7 C (98.1 F), blood pressure is 132/84 mm Hg, and pulse is 94/min. The patient precipitously delivers an infant weighing 4.1 kg (9 lb 2 oz). After delivery of the infant, small placental fragments are removed in pieces via manual extraction. Profuse vaginal bleeding occurs, and intravenous lines are placed. Uterotonic medications are administered and vigorous uterine massage is performed. The uterine fundus is firm, but the bleeding continues. Which of the following is the most likely cause of this patient's ongoing vaginal bleeding?

- ☐ A. Full-thickness rupture of the uterine myometrium (6%)
- ☐ B. Hypertension-induced placental detachment (1%)
- ☐ C. Inadequate uterine contraction (9%)
- ☐ D. Infection of the uterus and placental membranes (1%)
- ☒ E. Placental invasion into the uterine myometrium (81%)

Correct

81%



01 min, 19 secs



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Placenta accreta



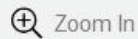
Endometrium

Myometrium

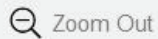
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deciduaAccreta
(78%)Increta
(17%)Percreta
(5%)

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This patient's **postpartum hemorrhage** (PPH) is likely due to **placental invasion into the myometrium**, which characterizes **placenta accreta** spectrum. The disease range is defined by depth of placental invasion: placenta accreta (attachment to the myometrium), placenta increta (invasion into the myometrium), and placenta percreta (invasion through the myometrium and serosa).

Placenta accreta disorders occur due to placental invasion through **defects in the decidua basalis** of the endometrium, which are commonly caused by uterine scarring from prior uterine surgery (eg, **cesarean delivery**, dilation and curettage). The absence of an intact decidual layer and subsequent direct placental attachment to the myometrium makes for a difficult placental delivery. Usually, manual placental extraction is attempted but yields only **small placental fragments** due to dense adhesions between the placenta and the uterus that **bleed profusely** if injured.

(Choice A) **Uterine rupture**, a full-thickness myometrial disruption, can cause vaginal bleeding; however, patients typically have antepartum (not postpartum) bleeding and intense abdominal pain. It would not cause difficulty with placental detachment.

(Choice B) **Abruptio placentae** is premature placental separation from the uterus; it can occur secondary to hypertension-induced placental vessel rupture. Unlike placenta accreta, abruptio placentae causes antepartum bleeding and promotes, rather than delays, placental detachment.



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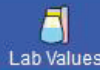
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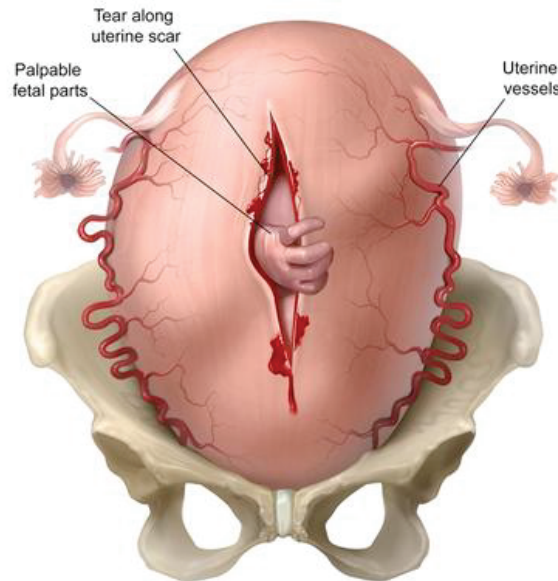
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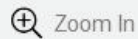
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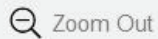
Uterine rupture



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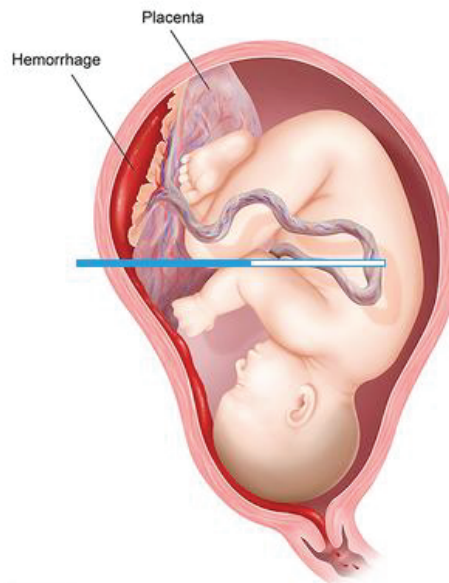
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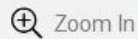
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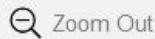
Placental abruption



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(Choice B) *Abruptio placentae* is premature placental separation from the uterus; it can occur secondary to hypertension-induced placental vessel rupture. Unlike placenta accreta, abruptio placentae causes antepartum bleeding and promotes, rather than delays, placental detachment.

(Choice C) Uterine atony (ie, poor uterine contractility) is the most common cause of PPH and typically presents with a soft, boggy uterine fundus. This patient's firm uterine fundus and unresponsiveness to uterotonic medications (which contract the uterus) make this diagnosis less likely.

(Choice D) Intraamniotic infection can cause vaginal bleeding and an inflamed, adherent placenta. However, the anatomic plane between the placenta and uterus remains intact and therefore does not cause placental fragmentation. In addition, this patient has no fever or purulent amniotic fluid, making this diagnosis unlikely.

Educational objective:

Placenta accreta spectrum occurs due to placental invasion into the myometrium through defects in the decidua basalis. This creates a morbidly adherent placenta that does not detach after fetal delivery, leading to postpartum hemorrhage. Manual placental extraction typically yields small placental fragments and increases bleeding.

References





A 37-year-old woman, gravida 2 para 1, at 30 weeks gestation comes to the office for a routine prenatal examination. She has no medical problems and takes a daily prenatal vitamin. Her pregnancy has been uncomplicated to date, and fetal movement is present. The patient has no vaginal bleeding, contractions, or loss of fluid. Physical examination shows a uterine size consistent with dates and a fetal heart rate of 160/min. Routine blood work obtained before pregnancy showed no abnormalities. At the last visit, she drank a solution containing 50 g of glucose, and serum glucose was abnormally elevated an hour later. Which of the following hormones is most likely contributing to this patient's abnormal laboratory findings?

- ☐ A.hCG
- ☐ B.Human placental lactogen
- ☐ C.Oxytocin
- ☐ D.Prolactin
- ☐ E. Thyroxine

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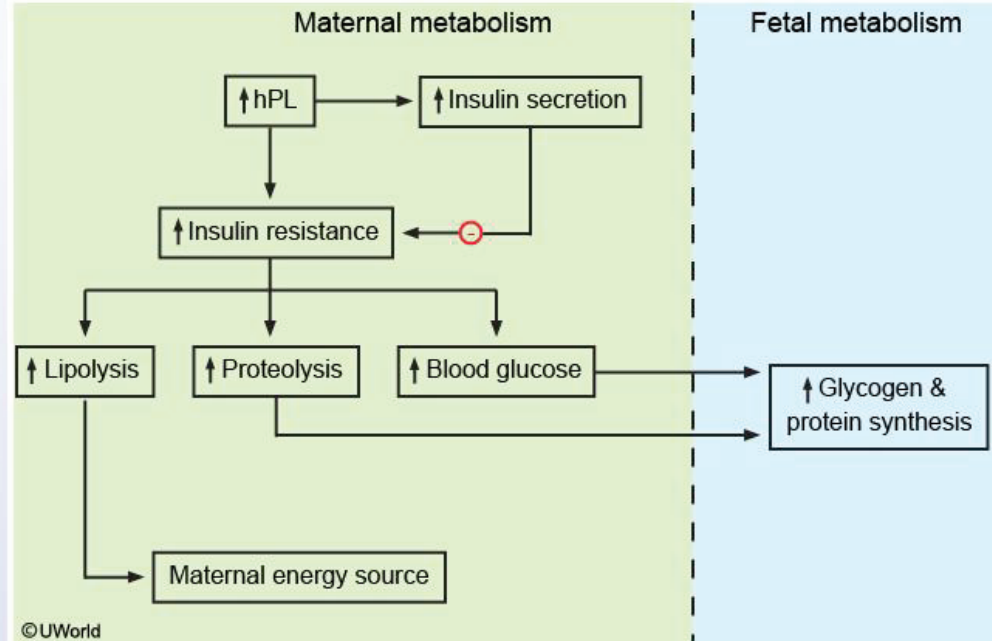


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- ☐ A.hCG (13%)
- ☒ B.Human placental lactogen (70%)
- ☐ C.Oxytocin (1%)
- ☐ D.Prolactin (5%)
- ☐ E. Thyroxine (9%)



Metabolic effects of human placental lactogen



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A physiologic increase in maternal **insulin resistance** occurs during the **second and third trimesters** to ensure a readily available supply of glucose and amino acids to the fetus. This increase in insulin



A physiologic increase in maternal **insulin resistance** occurs during the **second and third trimesters** to ensure a readily available supply of glucose and amino acids to the fetus. This increase in insulin resistance is primarily due to the action of **human placental lactogen (hPL)**, a peptide hormone secreted by the syncytiotrophoblast. The rise in insulin resistance leads to **increased glucose levels** in the maternal circulation; glucose freely crosses the placenta and is continuously consumed by the fetus for energy. Maternal lipolysis is also increased by hPL, with the resulting free fatty acids and ketones providing energy to the mother (preserving glucose and amino acids for the fetus). In cases of maternal malnutrition, the increased ketones can also provide the fetus with energy.

hPL also **stimulates pancreatic beta cell insulin production**. Gestational diabetes mellitus results when pancreatic function is not sufficient to overcome the pregnancy-related increase in insulin resistance. The average levels of hPL rise with increasing gestational age, reflecting the increasing energy requirements of the growing fetus. Screening for **gestational diabetes** is therefore more accurate in the third trimester and can be done with an **oral glucose challenge** and subsequent measurement of serum glucose levels.

(Choice A) In early pregnancy, the placental **syncytiotrophoblast** secretes human chorionic gonadotropin, a peptide hormone, which stimulates the corpus luteum to produce progesterone, a steroid hormone.

Progesterone is necessary to maintain the secretory endometrium, allowing the pregnancy to persist.





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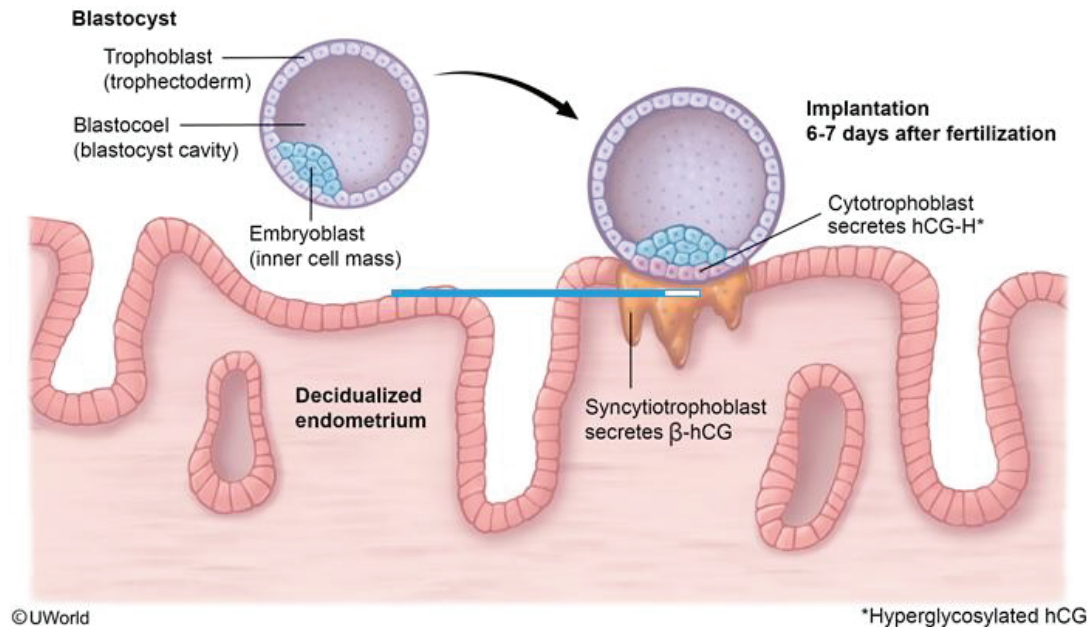
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Blastocyst implantation



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(Choice A) In early pregnancy, the placental **syncytiotrophoblast** secretes human chorionic gonadotropin, a peptide hormone, which stimulates the corpus luteum to produce progesterone, a steroid hormone. Progesterone is necessary to maintain the secretory endometrium, allowing the pregnancy to persist through term.

(Choice C) Oxytocin plays an important role in uterine contraction and the milk letdown reflex, but it does not affect glucose and lipid metabolism.

(Choice D) Prolactin is a peptide hormone secreted by lactotroph cells in the anterior pituitary. Prolactin is responsible for milk production and lactation in postpartum women.

(Choice E) Pregnancy increases the levels of thyroid-binding globulin, leading to increased total circulating T_3 and T_4 . However, free thyroid hormone levels remain essentially normal.

Educational objective:

Human placental lactogen increases maternal insulin resistance during the second and third trimesters, leading to a rise in serum glucose that helps provide adequate nutrition to the growing fetus. Gestational diabetes occurs when the compensatory rise in maternal insulin secretion is inadequate to prevent serum glucose levels from reaching excessively high levels.





A 29-year-old woman with a history of type 1 diabetes mellitus goes into labor during her 38th week of gestation. She received regular prenatal care, but her blood glucose levels were poorly controlled throughout the pregnancy. During the second stage of labor, fetal descent fails to progress and the infant is delivered by caesarean section. Apgar scores were 8 and 9 at 1 and 5 minutes, respectively. Physical examination shows an infant large for gestational age but is otherwise normal. Which of the following metabolic disturbances is most likely to develop in the neonate?

- ☐ A. Diabetic ketoacidosis
- ☐ B. Hyperthyroidism
- ☐ C. Persistent hypoglycemia
- ☐ D. Transient hyperglycemia
- ☐ E. Transient hypoglycemia

Submit



A 29-year-old woman with a history of type 1 diabetes mellitus goes into labor during her 38th week of gestation. She received regular prenatal care, but her blood glucose levels were poorly controlled throughout the pregnancy. During the second stage of labor, fetal descent fails to progress and the infant is delivered by caesarean section. Apgar scores were 8 and 9 at 1 and 5 minutes, respectively. Physical examination shows an infant large for gestational age but is otherwise normal. Which of the following metabolic disturbances is most likely to develop in the neonate?

- ☐ A. Diabetic ketoacidosis (1%)
- ☐ B. Hyperthyroidism (0%)
- ☐ C. Persistent hypoglycemia (8%)
- ☐ D. Transient hyperglycemia (12%)
- ☒ E. Transient hypoglycemia (76%)

Correct



76%

Answered correctly



54 secs

Time Spent



09/07/2020

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Neonatal complications of diabetes during pregnancy

Pathogenesis

- Maternal hyperglycemia → fetal hyperglycemia & hyperinsulinemia
- ↑ Fetal fat & glycogen stores
- ↑ Fetal metabolic demand

Associated risks

- Prematurity
- Congenital anomalies (eg, caudal regression syndrome)
- Macrosomia & associated complications (eg, brachial plexus injury, clavicle fracture)
- Respiratory distress syndrome
- Hypertrophic cardiomyopathy

Laboratory findings

- Hypoglycemia
- Polycythemia, low iron
- Hypocalcemia & hypomagnesemia
- Hyperbilirubinemia





• Hyperbilirubinemia

Diabetes during pregnancy is associated with a number of neonatal complications, including **transient hypoglycemia**. In pregnant women with poorly controlled diabetes mellitus, the fetus is subjected to high blood glucose levels since glucose freely crosses the placenta; however, maternal insulin is not able to cross the placenta. The resulting fetal hyperglycemia leads to a compensatory rise in fetal insulin production and islet cell hyperplasia. Fetal hyperinsulinemia promotes abnormal fetal growth, resulting in **macrosomia**. After birth, the neonate is no longer exposed to the mother's high blood glucose levels, but a hyperinsulinemic state persists for several days, predisposing the neonate to developing hypoglycemia.

(Choices A and D) Diabetic ketoacidosis and hyperglycemia do not occur in the newborn of a diabetic mother even if diabetes is poorly controlled during pregnancy, as the fetus is able to synthesize appropriate amounts of insulin.

(Choice B) Graves' disease during pregnancy can be complicated by neonatal hyperthyroidism caused by placental transfer of maternal thyroid-stimulating antibodies.

(Choice C) Hypoglycemia in the neonate of a diabetic mother typically resolves within 3-7 days of birth as the hyperinsulinemia remits. Persistent hypoglycemia should prompt investigation for inborn metabolic abnormalities or genetic defects affecting insulin secretion (eg, persistent hyperinsulinemic hypoglycemia of





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(Choice C) Hypoglycemia in the neonate of a diabetic mother typically resolves within 3-7 days of birth as the hyperinsulinemia remits. Persistent hypoglycemia should prompt investigation for inborn metabolic abnormalities or genetic defects affecting insulin secretion (eg, persistent hyperinsulinemic hypoglycemia of infancy).

Educational objective:

Neonates born to mothers with poorly controlled diabetes during pregnancy are exposed to high maternal glucose levels in utero, resulting in excessive fetal insulin production and islet hyperplasia. Fetal hyperinsulinemia persists for several days following birth and predisposes the infant to transient hypoglycemia.

References

- [Hypoglycemia rates in the first days of life among term infants born to diabetic mothers.](#)

Pathology Pregnancy, Childbirth & Puerperium Diabetes mellitus

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During the first trimester of pregnancy, a 22-year-old immigrant from the Middle East develops a low-grade fever and maculopapular rash. Over 48 hours, the rash spreads from her face and chest to her trunk and extremities. Physical examination also detects postauricular lymphadenopathy. The mother is at risk for which of the following immediate complications (from the first column), and the fetus is at risk for which of the following congenital defects (from the second column)?

- | | Mother | Infant |
|--------------------------|----------------|-----------------|
| <input type="radio"/> A. | Polyarthralgia | deafness |
| <input type="radio"/> B. | Deafness | bowlegs |
| <input type="radio"/> C. | Polyarthralgia | macrocephaly |
| <input type="radio"/> D. | Meningitis | malformed teeth |
| <input type="radio"/> E. | Pneumonia | cataracts |

Submit



During the first trimester of pregnancy, a 22-year-old immigrant from the Middle East develops a low-grade fever and maculopapular rash. Over 48 hours, the rash spreads from her face and chest to her trunk and extremities. Physical examination also detects postauricular lymphadenopathy. The mother is at risk for which of the following immediate complications (from the first column), and the fetus is at risk for which of the following congenital defects (from the second column)?

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| <input type="radio"/> C. | Polyarthralgia | macrocephaly |
| <input type="radio"/> D. | Meningitis | malformed teeth |
| <input type="radio"/> E. | Pneumonia | cataracts |

Submit



During the first trimester of pregnancy, a 22-year-old immigrant from the Middle East develops a low-grade fever and maculopapular rash. Over 48 hours, the rash spreads from her face and chest to her trunk and extremities. Physical examination also detects postauricular lymphadenopathy. The mother is at risk for which of the following immediate complications (from the first column), and the fetus is at risk for which of the following congenital defects (from the second column)?

	Mother	Infant	
<input checked="" type="radio"/>	A. Polyarthralgia	deafness	(66%)
<input type="radio"/>	B. Deafness	bowlegs	(2%)
<input type="radio"/>	C. Polyarthralgia	macrocephaly	(8%)
<input type="radio"/>	D. Meningitis	malformed teeth	(4%)
<input type="radio"/>	E. Pneumonia	cataracts	(17%)

Correct

66%

41 secs

01/30/2021

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This patient's immigration history suggests that she may not have been vaccinated against measles, mumps, and rubella (MMR) at 12-15 months of age. Measles (rubeola) and German measles (rubella) are two acute viral exanthems whose maculopapular rashes begin on the head and neck and spread downward. Generalized lymphadenopathy, particularly postauricular and occipital, is typically more prominent in rubella. Most adult women with rubella develop polyarthrititis and polyarthralgia as sequelae.

Fetal infection with the rubella virus during the first trimester can cause sensorineural deafness, cataracts, and cardiac malformations like a patent ductus arteriosus. Maternal deafness, meningitis, or pneumonia would be very unlikely.

(Choice D) Malformed teeth such as Hutchinson's incisors and mulberry molars are typical late manifestations of congenital syphilis.

Educational Objective:

Maternal rubella infection produces a low-grade fever, a maculopapular rash with cephalocaudal progression, and posterior auricular and suboccipital lymphadenopathy. Most adult women patients develop polyarthrititis and polyarthralgia as sequelae. Congenital rubella syndrome is associated with sensorineural deafness, cataracts, and cardiac malformations (PDA).





A 29-year-old woman is brought to the emergency department after a syncopal episode while getting out of bed. Yesterday, the patient developed right-sided abdominal pain, which has spread across the lower abdomen over the past few hours. She also noticed a blood stain on her underwear after the syncopal episode. Her last menstrual period was 8 weeks ago. The patient uses condoms intermittently for contraception. Temperature is 37 C (98.6 F), blood pressure is 90/60 mm Hg, and pulse is 125/min. The patient has diffuse lower abdominal pain with rebound tenderness and voluntary guarding. Pelvic examination shows cervical motion tenderness and right-sided adnexal tenderness; no masses are palpated. Which of the following is the most likely diagnosis for this patient?

- ☐ A. Acute appendicitis
- ☐ B. Ovarian torsion
- ☐ C. Pelvic inflammatory disease
- ☐ D. Ruptured ectopic pregnancy
- ☐ E. Tuboovarian abscess





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- ☐ A. Acute appendicitis (0%)
- ☐ B. Ovarian torsion (4%)
- ☐ C. Pelvic inflammatory disease (6%)
- ☒ D. Ruptured ectopic pregnancy (87%)
- ☐ E. Tuboovarian abscess (0%)

Correct

87%



59 secs



12/03/2020

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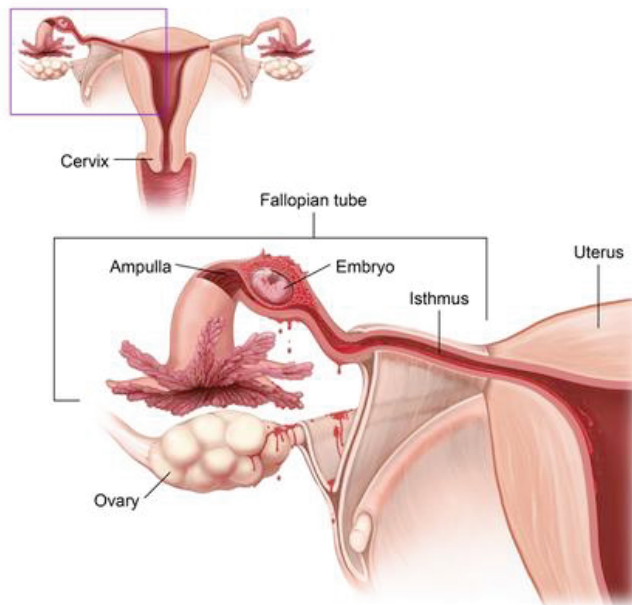
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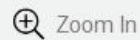
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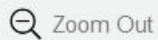
Ectopic pregnancy with ruptured fallopian tube



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This patient with diffuse abdominal pain, rebound tenderness with guarding, and hemodynamic instability (eg, hypotension, tachycardia, syncope) likely has **intraabdominal bleeding** (ie, hemoperitoneum). In the setting of a **missed menstrual cycle** (ie, last menstrual period 8 weeks ago), **right adnexal tenderness**, and vaginal bleeding, the most likely cause is a **ruptured ectopic pregnancy**.

Ectopic pregnancies occur due to implantation in an **extrauterine location**, most commonly the fallopian tube. Unlike the uterus, which has a thick wall of distensible smooth muscle, the fallopian tube cannot expand as the ectopic pregnancy enlarges. This strain on the tubal wall, in addition to surrounding tissue ischemia (from the redirection of blood flow toward the pregnancy), causes unilateral abdominal pain and tubal rupture. Rupture at this highly vascular site typically results in brisk intraabdominal bleeding.

Because blood is highly irritating to the peritoneum, patients with **hemoperitoneum** usually develop diffuse abdominal pain with rebound and guarding; low-grade fever (due to inflammation) is also common.

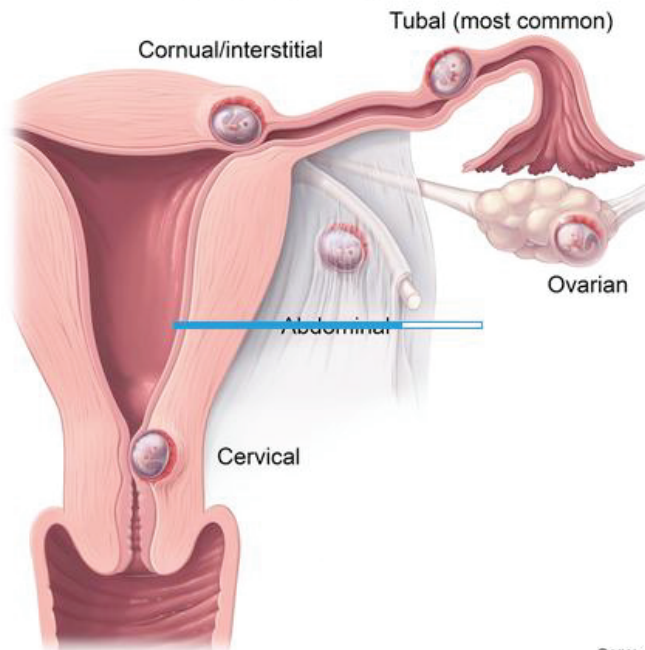
Patients with blood accumulation in the posterior cul-de-sac can also have cervical motion tenderness and a strong urge to defecate. Patients with hemodynamic instability (eg, orthostatic hypotension, syncopal episode) require urgent surgical management.

(Choice A) Acute appendicitis can present with right lower abdominal pain that progresses to diffuse pain in cases of appendiceal rupture (ie, peritonitis from spilled intestinal contents). However, this diagnosis is



Exhibit Display

Ectopic pregnancy locations



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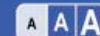
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(Choice A) Acute appendicitis can present with right lower abdominal pain that progresses to diffuse pain in cases of appendiceal rupture (ie, peritonitis from spilled intestinal contents). However, this diagnosis is less likely in this patient who also has a missed menstrual cycle and vaginal bleeding.

(Choice B) **Ovarian torsion** can cause unilateral abdominal pain and adnexal tenderness; patients with prolonged torsion may develop rebound and guarding due to ovarian necrosis. However, the pain is typically sudden onset (ie, acute occlusion of ovarian blood flow) and vaginal bleeding is uncommon. An adnexal mass (not present in this patient) may be palpable.

(Choices C and E) Pelvic inflammatory disease (PID) typically presents with abdominal pain and cervical motion tenderness due to infection and inflammation of the upper genital tract. Tuboovarian abscess (TOA) is a severe form of PID that has localized to the adnexa. Unlike this patient, those with PID or TOA are typically febrile with malodorous cervical discharge.

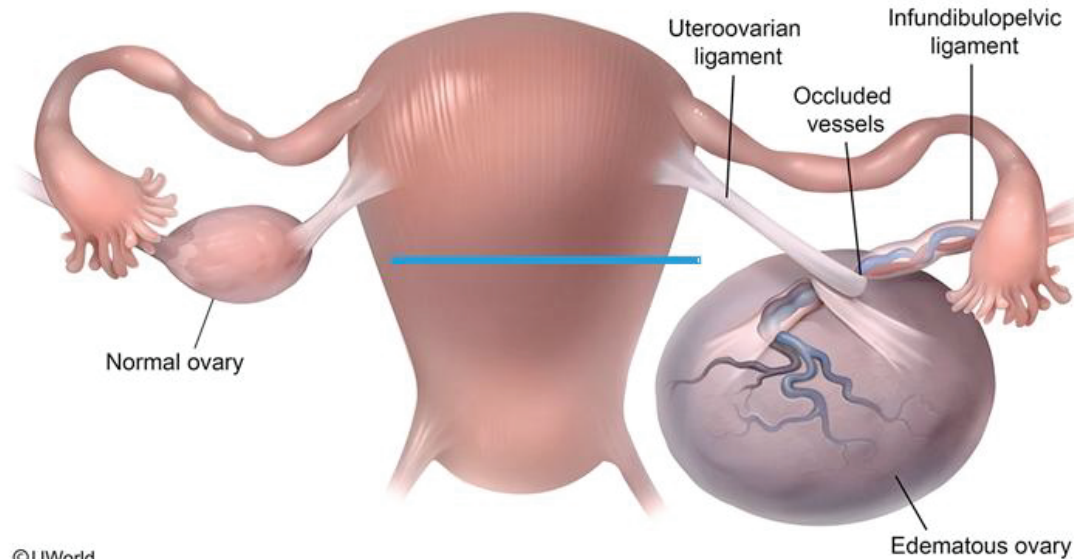
Educational objective:

Ectopic pregnancy may present with unilateral lower abdominal pain, adnexal tenderness, and vaginal bleeding. Patients with a ruptured ectopic pregnancy have severe intraabdominal bleeding, which causes diffuse abdominal pain with rebound/guarding and hemodynamic instability.



Exhibit Display

Ovarian torsion



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A 7-year-old boy is evaluated for fatigue. For the last year, he has been avoiding any significant outdoor activities with his peers due to poor energy and shortness of breath. He also describes occasional pounding in the chest. Physical examination shows a holosystolic murmur best heard at the lower sternal border. Echocardiography reveals apical displacement of the tricuspid valve leaflets, decreased right ventricular volume, and atrialization of the right ventricle. Moderate to severe tricuspid regurgitation is also present. If this patient's diagnosis is due to a side effect of a drug taken during pregnancy, his biological mother most likely had which of the following conditions?

- ☐ A. Alcohol abuse
- ☐ B. Bipolar disorder
- ☐ C. Cocaine abuse
- ☐ D. Down syndrome
- ☐ E. Epilepsy
- ☐ F. Gestational diabetes
- ☐ G. Hypothyroidism

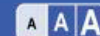




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- ☐ D. Down syndrome
- ☐ E. Epilepsy
- ☐ F. Gestational diabetes
- ☐ G. Hypothyroidism
- ☐ H. Opioid abuse
- ☐ I. Schizophrenia





present. If this patient's diagnosis is due to a side effect of a drug taken during pregnancy, his biological mother most likely had which of the following conditions?

- ☐ A. Alcohol abuse (4%)
- ☒ B. Bipolar disorder (74%)
- ☐ C. Cocaine abuse (3%)
- ☐ D. Down syndrome (0%)
- ☐ E. Epilepsy (9%)
- ☐ F. Gestational diabetes (2%)
- ☐ G. Hypothyroidism (1%)
- ☐ H. Opioid abuse (0%)
- ☐ I. Schizophrenia (2%)

Correct

74%



55 secs



09/05/2020

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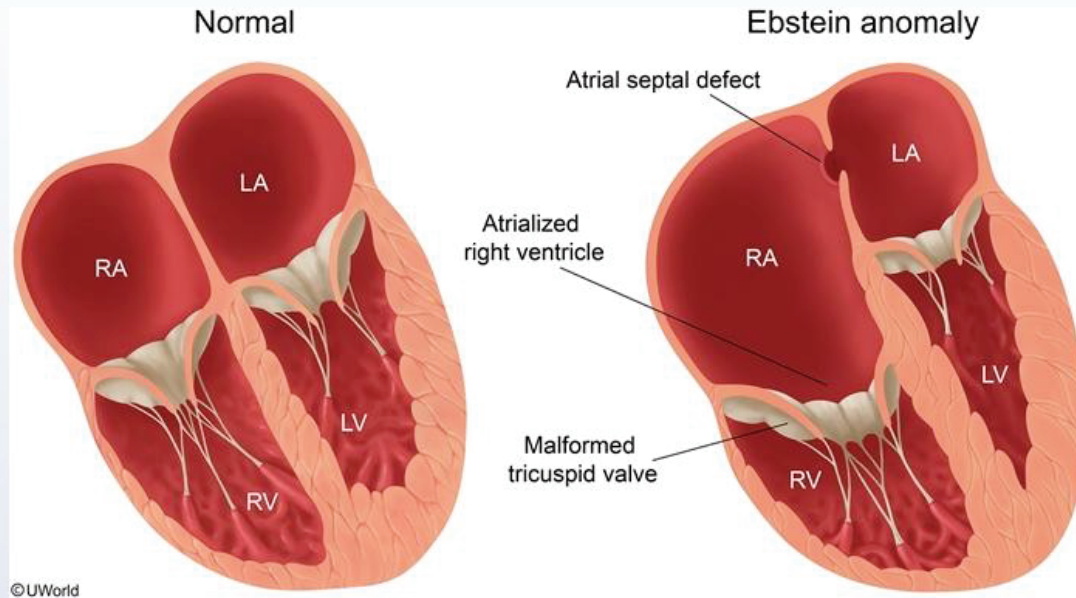
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In patients with **bipolar disorder**, **lithium** is used to treat acute mania, hypomania, and bipolar and unipolar depression. Long-term treatment may also reduce the risk of suicide attempts and deaths. Lithium is potentially teratogenic; in utero exposure is associated with Ebstein's anomaly in infants. Ebstein's anomaly is characterized by apical displacement of the tricuspid valve leaflets, decreased volume



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(Choice A) Alcohol abuse during pregnancy may result in **fetal alcohol syndrome**, which is characterized by dysmorphic facies, growth retardation, and central nervous system abnormalities.

(Choice C) Prenatal cocaine abuse increases the risk of preeclampsia, spontaneous abortion, fetal demise, and placental abruption.

(Choice D) Atrial and ventricular septal defects are the most common congenital cardiac anomalies in patients with **Down syndrome**.

(Choice E) Seizures are not associated with major fetal malformations, but antiepileptic drugs (AEDs) significantly increase the risk of **neural tube**, renal, skeletal, and cleft palate abnormalities. Although AEDs also increase the risk of congenital heart defects, they are not associated with Ebstein's anomaly.

(Choice F) Gestational diabetes is associated with fetal macrosomia, caudal regression syndrome,





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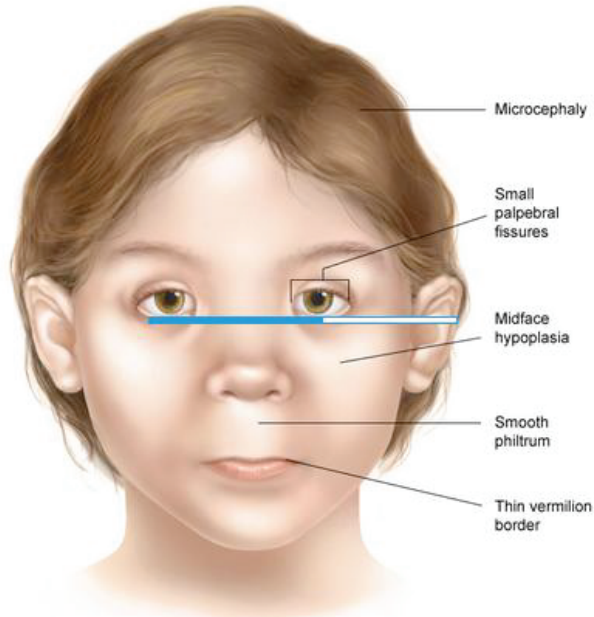
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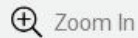
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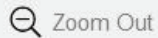
Fetal alcohol syndrome



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Down syndrome comorbidities	
Neurology	<ul style="list-style-type: none"> Intellectual disability Early-onset Alzheimer disease
Cardiology	<ul style="list-style-type: none"> Complete atrioventricular septal defect Ventricular septal defect Atrial septal defect
Gastroenterology	<ul style="list-style-type: none"> Duodenal atresia Hirschsprung disease
Endocrinology	<ul style="list-style-type: none"> Hypothyroidism Type 1 diabetes mellitus Obesity
Hematology	<ul style="list-style-type: none"> Acute leukemia
Rheumatology	<ul style="list-style-type: none"> Atlantoaxial instability

In patients with bip

unipolar depression

Lithium is potentiall

Ebstein's anomaly

of the right ventricle

(Choice A) Alcohol

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(Choice D) Atrial a

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(Choice E) Seizur

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(Choice F) Gestat

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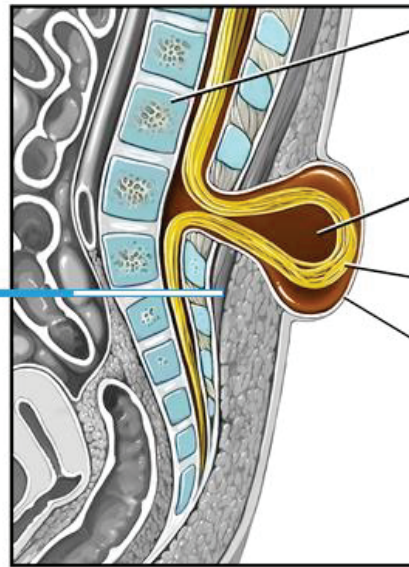
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Open spina bifida



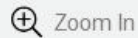
Vertebra

Spinal fluid

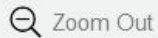
Spinal cord

Dura

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also increase the risk of congenital heart defects, they are not associated with Ebstein's anomaly.

(Choice F) Gestational diabetes is associated with fetal macrosomia, caudal regression syndrome, hypoglycemia, hypocalcemia, and hypertrophic cardiomyopathy.

(Choice G) Untreated maternal hypothyroidism in pregnancy is associated with obstetric complications and cognitive impairment in offspring.

(Choice H) Opioid abuse may cause neonatal withdrawal symptoms (irritability, diarrhea, vomiting) after delivery. Opioid dependence increases the risk of multiple obstetric complications but not major cardiac defects.

(Choice I) Schizophrenia and antipsychotics are not associated with the development of major fetal malformations.

Educational objective:

Lithium is commonly used to treat bipolar disorder. Its use during pregnancy is associated with Ebstein's anomaly, which is characterized by apical displacement of the tricuspid valve leaflets, decreased right ventricular volume, and atrialization of the right ventricle.

References





An 18-year-old woman comes to the office for evaluation of acne. The patient is very upset about the acne scarring, which worsened since she started college. She has been very stressed by upcoming examinations and feels "exhausted" due to lack of adequate sleep. The patient has been using topical benzoyl peroxide and tretinoin for the past year. She was also prescribed an oral antibiotic but stopped taking it several months ago due to lack of improvement. The patient is sexually active with her boyfriend and uses an intrauterine device for contraception. Her periods are regular and last 5 days. She takes no other medications and does not use tobacco, alcohol, or illicit drugs. Physical examination shows nodulocystic acne with scarring on the face, chin, and upper back. The patient is interested in isotretinoin treatment. Which of the following is the best next step in management of this patient?

- ☐ A. Bone density test
- ☐ B. Pelvic ultrasound
- ☐ C. Removal of intrauterine device
- ☒ D. Serum retinol level
- ☐ E. Serum testosterone



benzoyl peroxide and tretinoin for the past year. She was also prescribed an oral antibiotic but stopped taking it several months ago due to lack of improvement. The patient is sexually active with her boyfriend and uses an intrauterine device for contraception. Her periods are regular and last 5 days. She takes no other medications and does not use tobacco, alcohol, or illicit drugs. Physical examination shows nodulocystic acne with scarring on the face, chin, and upper back. The patient is interested in isotretinoin treatment. Which of the following is the best next step in management of this patient?

- ☐ A. Bone density test
- ☐ B. Pelvic ultrasound
- ☐ C. Removal of intrauterine device
- ☐ D. Serum retinol level
- ☐ E. Serum testosterone
- ☐ F. Serum TSH level
- ☐ G. Urine β -hCG

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benzoyl peroxide and tretinoin for the past year. She was also prescribed an oral antibiotic but stopped

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benzoyl peroxide and tretinoin for the past year. She was also prescribed an oral antibiotic but stopped taking it several months ago due to lack of improvement. The patient is sexually active with her boyfriend and uses an intrauterine device for contraception. Her periods are regular and last 5 days. She takes no other medications and does not use tobacco, alcohol, or illicit drugs. Physical examination shows nodulocystic acne with scarring on the face, chin, and upper back. The patient is interested in isotretinoin treatment. Which of the following is the best next step in management of this patient?

- ☐ A. Bone density test (0%)
- ☐ B. Pelvic ultrasound (2%)
- ☐ C. Removal of intrauterine device (2%)
- ☐ D. Serum retinol level (4%)
- ☐ E. Serum testosterone (4%)
- ☐ F. Serum TSH level (1%)
- ☒ G. Urine β -hCG (84%)



Side effects of oral isotretinoin therapy

- Teratogenic (eg, spontaneous abortion, fetal malformations)
- Hyperlipidemia
- Chelitis, dry skin
- Myalgias
- Pseudotumor cerebri

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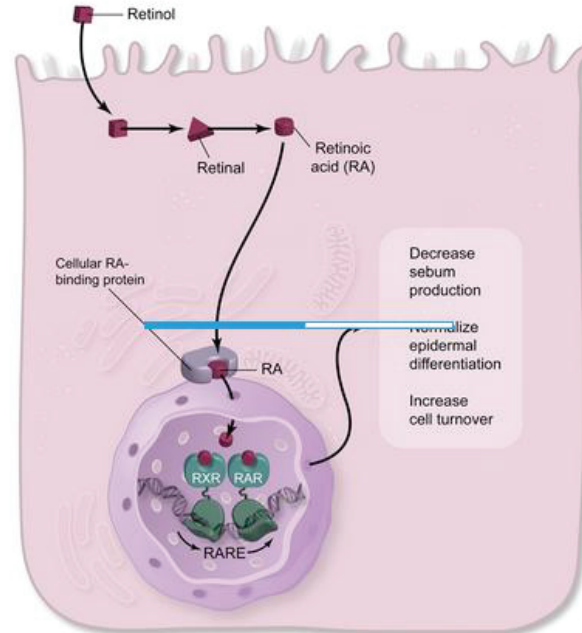
Isotretinoin is a synthetic 13-*cis*-isomer of naturally occurring all-*trans*-retinoic acid (tretinoin), a derivative of vitamin A. It can be administered orally to treat severe acne associated with significant **scarring**. It is also indicated in patients who fail therapy with topical tretinoin/benzoyl peroxide and antibiotics. **Retinoids** inhibit follicular epidermal keratinization, thereby loosening the keratin plugs of comedones and facilitating their expulsion. They also reduce the size of sebaceous glands and inhibit sebum production.

Isotretinoin is a potent teratogen and is absolutely **contraindicated in pregnancy**. Exposure to this medication can cause spontaneous abortion and a variety of severe fetal anomalies. A **negative pregnancy test** (urine or serum) is required prior to prescribing, and abstinence/contraception is recommended. Monthly pregnancy testing is required during treatment. An intrauterine device (IUD) is a long-term contraception method that is 99% effective and safe to use in women of all ages. It should not be



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Retinoid mechanism of action



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pregnancy test (urine or serum) is required prior to prescribing, and abstinence/contraception is recommended. Monthly pregnancy testing is required during treatment. An intrauterine device (IUD) is a long-term contraception method that is 99% effective and safe to use in women of all ages. It should not be discontinued in this patient (**Choice C**). Because no contraception method is 100% effective, condom use as a backup method is advised.

(Choice A) Bone density testing is recommended in patients on long-term glucocorticoid therapy because these drugs increase bone resorption and reduce bone formation. Skeletal complications from isotretinoin therapy are rare.

(Choices B and E) Pelvic ultrasound and serum testosterone are used to diagnose polycystic ovary syndrome (PCOS), a major underlying cause of acne. PCOS commonly presents with oligomenorrhea and hirsutism, which are absent in this patient. Pelvic ultrasound often reveals ovaries with multiple small cysts. Treatment with oral contraceptives restores menses and alleviates acne.

(Choice D) Vitamin A deficiency is rare in developed countries. Unlike vitamin A, isotretinoin is not stored in the liver and is therefore not associated with toxicities seen with high-dose vitamin A intake. Serum retinol measurement is not indicated.

(Choice F) Hypothyroidism commonly causes fatigue in addition to cold intolerance and constipation, but it





hirsutism, which are absent in this patient. Pelvic ultrasound often reveals ovaries with multiple small cysts. Treatment with oral contraceptives restores menses and alleviates acne.

(Choice D) Vitamin A deficiency is rare in developed countries. Unlike vitamin A, isotretinoin is not stored in the liver and is therefore not associated with toxicities seen with high-dose vitamin A intake. Serum retinol measurement is not indicated.

(Choice F) Hypothyroidism commonly causes fatigue in addition to cold intolerance and constipation, but it does not cause acne. In addition, serum TSH would be elevated in a patient with hypothyroidism.

Educational objective:

Isotretinoin is used to treat severe acne with significant scarring. Pregnancy is an absolute contraindication due to the risk of teratogenicity. Sexually active women should be advised to use 2 forms of contraception and take monthly pregnancy tests.

References

- Possible long-term teratogenic effect of isotretinoin in pregnancy.
- ACOG Practice Bulletin No. 121: Long-acting reversible contraception: Implants and intrauterine devices.





A 35-year-old woman, gravida 1 para 0, at 40 weeks gestation has a protracted labor course for which a cesarean delivery is performed under epidural anesthesia. Shortly after delivery, the patient has chest pain and difficulty breathing. She becomes hypotensive, bradycardic, hypoxic, and unresponsive, and undergoes emergency intubation. The surgical incisions begin to bleed profusely and the patient goes into cardiorespiratory arrest. She is declared dead after 30 minutes of cardiopulmonary resuscitation. The family agrees to an autopsy. Which of the following is the most likely finding during histologic evaluation of her lungs?

- ☐ A. Alveolar ducts lined with hyaline membranes
- ☐ B. Enlargement of air spaces and alveolar septal destruction
- ☐ C. Giant cell foreign body response in the lower lobe of the right lung
- ☐ D. Pulmonary arterioles with lipid globules
- ☐ E. Pulmonary artery branch with swirls of fetal squamous cells

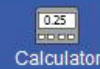
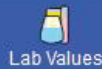
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A 35-year-old woman, gravida 1 para 0, at 40 weeks gestation has a protracted labor course for which a cesarean delivery is performed under epidural anesthesia. Shortly after delivery, the patient has chest pain and difficulty breathing. She becomes hypotensive, bradycardic, hypoxic, and unresponsive, and undergoes emergency intubation. The surgical incisions begin to bleed profusely and the patient goes into cardiorespiratory arrest. She is declared dead after 30 minutes of cardiopulmonary resuscitation. The family agrees to an autopsy. Which of the following is the most likely finding during histologic evaluation of her lungs?

- ☐ A. Alveolar ducts lined with hyaline membranes (16%)
- ☐ B. Enlargement of air spaces and alveolar septal destruction (5%)
- ☐ C. Giant cell foreign body response in the lower lobe of the right lung (2%)
- ☐ D. Pulmonary arterioles with lipid globules (9%)
- ☒ E. Pulmonary artery branch with swirls of fetal squamous cells (66%)





Clinical features of amniotic fluid embolism

- Cardiogenic shock
- Hypoxemic respiratory failure
- Disseminated intravascular coagulation
- Seizures or coma

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This patient's presentation is classic for **amniotic fluid embolism** (AFE), a rare but catastrophic complication that can occur during pregnancy or shortly after delivery. Amniotic fluid containing arachidonic acid metabolites is thought to enter the maternal circulation through sites of uterine trauma or cervical lacerations; this results in an anaphylactoid reaction (caused by the metabolites). Amniotic fluid causes occlusion and vasospasm of the maternal pulmonary circulation, leading to left ventricular failure, decreased cardiac output, and a severe ventilation-perfusion mismatch. The resultant hypoxia and hypotensive shock may ultimately cause **cardiopulmonary arrest**. Tissue factor (thromboplastin) is also released from amniotic fluid and triggers disseminated intravascular coagulation, as seen in this patient. On autopsy, histology shows **fetal squamous cells** and mucin in the **maternal pulmonary arteries**.

(Choice A) The hallmark of acute respiratory distress syndrome (ARDS) is the presence of **hyaline**





(Choice A) The hallmark of acute respiratory distress syndrome (ARDS) is the presence of **hyaline membranes** (red arrow) lining the alveolar ducts. ARDS is usually the result of alveolar injury from sepsis, trauma, or pneumonia and presents with cough, dyspnea, and diffuse crackles. ARDS can develop after AFE but usually in patients who survive the early acute phase of AFE, which this patient did not.

(Choice B) Emphysema is a type of chronic obstructive pulmonary disease usually caused by smoking. Alveolar wall destruction results in permanent **air space enlargement** (red arrows) and symptoms such as exertional dyspnea, chronic cough, and sputum production. This patient's condition was acute with no sputum production.

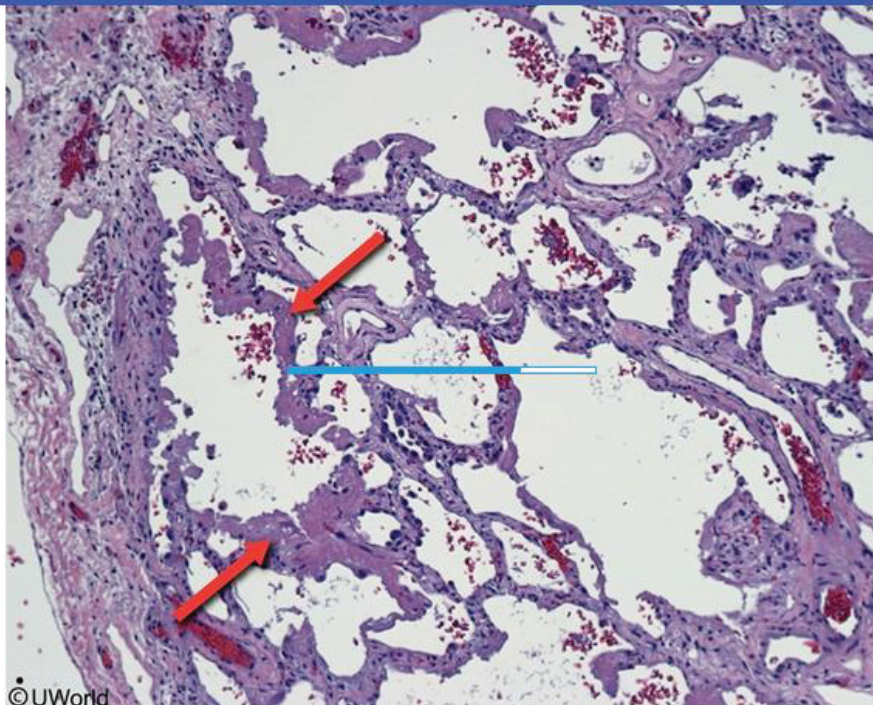
(Choice C) Aspiration pneumonia most commonly involves the lower lobe of the right lung. Histology shows inflammation and a foreign body response with **giant cells**. Risk factors for aspiration of gastric contents include recumbent position with impaired consciousness (eg, general anesthesia). Symptoms include hypoxia, but patients usually have fever and focal crackles.

(Choice D) A fractured bone (eg, femur, pelvis) can release lipid globules into the pulmonary vasculature, resulting in fat embolism syndrome. The syndrome may present with hypoxemia, tachypnea, dyspnea, and a petechial rash 1-3 days after the orthopedic injury and is not an obstetric complication.

Educational objective:



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Item 23 of 40

Question Id: 11919



Mark



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Next



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Tutorial



Lab Values



Notes



Calculator



Reverse Color

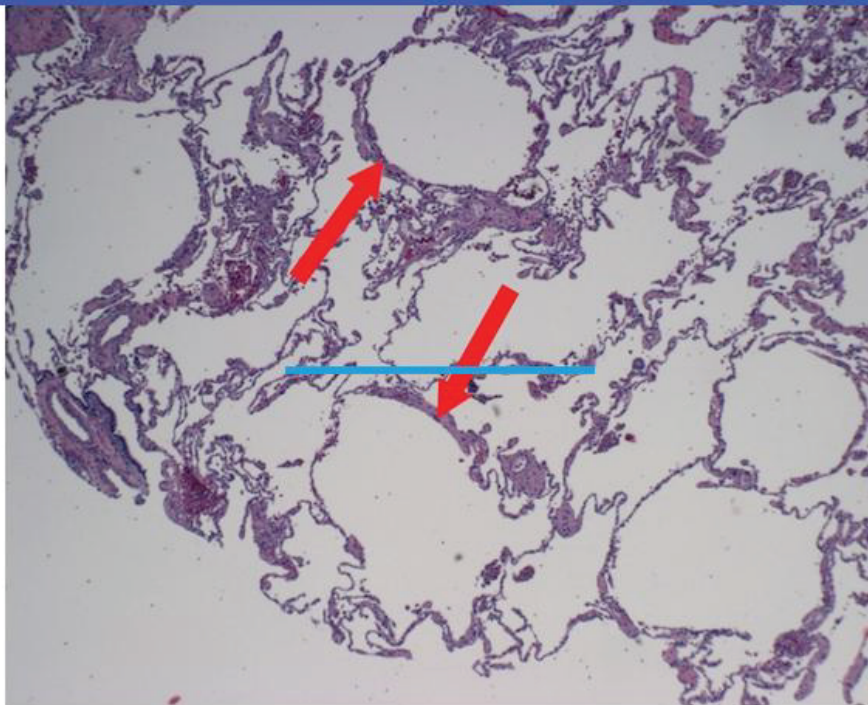


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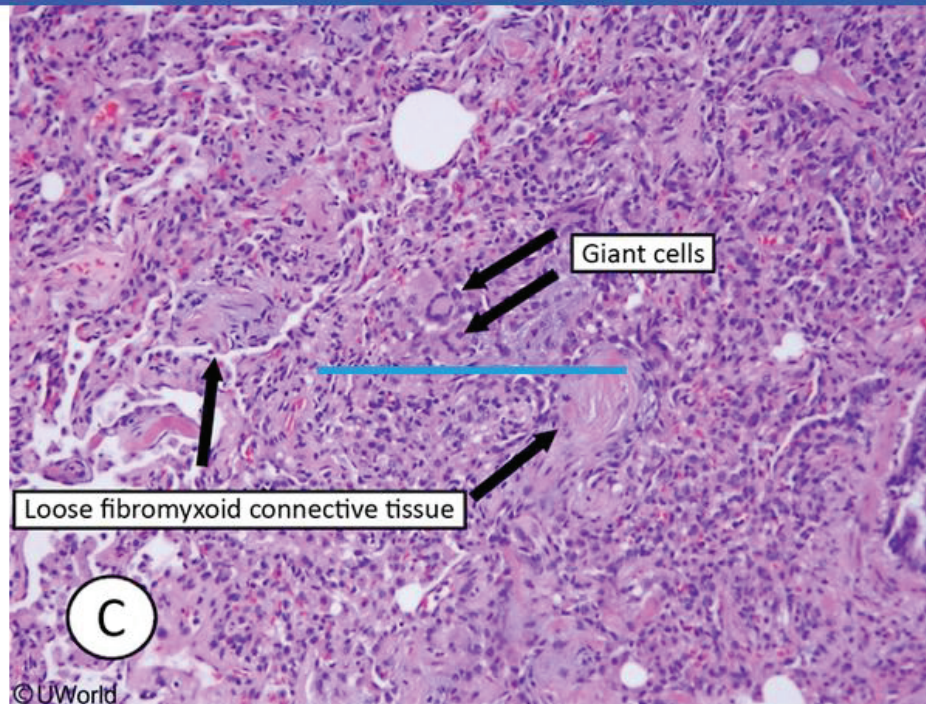


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(Choice C) Aspiration pneumonia most commonly involves the lower lobe of the right lung. Histology shows inflammation and a foreign body response with **giant cells**. Risk factors for aspiration of gastric contents include recumbent position with impaired consciousness (eg, general anesthesia). Symptoms include hypoxia, but patients usually have fever and focal crackles.

(Choice D) A fractured bone (eg, femur, pelvis) can release lipid globules into the pulmonary vasculature, resulting in fat embolism syndrome. The syndrome may present with hypoxemia, tachypnea, dyspnea, and a petechial rash 1-3 days after the orthopedic injury and is not an obstetric complication.

Educational objective:

Amniotic fluid embolism (AFE) is a rare and catastrophic pregnancy complication that results from amniotic fluid entering the maternal circulation. Common signs of AFE include hypoxia, hypotensive shock, and disseminated intravascular coagulation. Fetal squamous cells are seen in the pulmonary vasculature during histologic evaluation.

References

- [Amniotic fluid embolism: despite progress, challenges remain.](#)





A 27-year-old nulligravid woman comes to the office for a routine visit. Medical history is significant for epilepsy that is well controlled with valproate and chronic hypertension for which she takes nifedipine. She hopes to conceive in the next few months and plans to start prenatal vitamins soon. The patient takes no other medications and does not use tobacco, alcohol, or illicit drugs. Blood pressure is 120/80 mm Hg. Physical examination is normal. If the patient conceives now, her fetus is at increased risk for which of the following anomalies?

- ☐ A. Epiphyseal stippling
- ☐ B. Hypothyroidism
- ☐ C. Micrognathia
- ☐ D. Myelomeningocele
- ☐ E. Nasal hypoplasia
- ☐ F. Renal dysgenesis
- ☐ G. Tricuspid valve malformation





epilepsy that is well controlled with valproate and chronic hypertension for which she takes nifedipine. She hopes to conceive in the next few months and plans to start prenatal vitamins soon. The patient takes no other medications and does not use tobacco, alcohol, or illicit drugs. Blood pressure is 120/80 mm Hg. Physical examination is normal. If the patient conceives now, her fetus is at increased risk for which of the following anomalies?

- ☐ A. Epiphyseal stippling (1%)
- ☐ B. Hypothyroidism (1%)
- ☐ C. Micrognathia (5%)
- ☒ D. Myelomeningocele (78%)
- ☐ E. Nasal hypoplasia (1%)
- ☐ F. Renal dysgenesis (6%)
- ☐ G. Tricuspid valve malformation (5%)

Correct

78%



33 secs



02/16/2021

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**Teratogenic medications**

Drug	Adverse effects
Phenytoin	Neural tube defects, microcephaly, orofacial clefts, dysmorphic facial features, distal digit/nail hypoplasia
Lithium	Ebstein anomaly, nephrogenic diabetes insipidus, hypothyroidism
Valproate	Neural tube defects
Isotretinoin	Microcephaly, thymic hypoplasia, small ears, hydrocephalus
Methotrexate	Limb & craniofacial abnormalities, neural tube defects, abortion
ACE inhibitors	Renal dysgenesis, oligohydramnios
Warfarin	Neural tube defects, fetal death



**Warfarin**

Nasal hypoplasia, stippled epiphysis

Preconception counseling is recommended in reproductive-age women with chronic medical conditions and desire for pregnancy to optimize the patient's health and identify risk factors for potential obstetric complications.

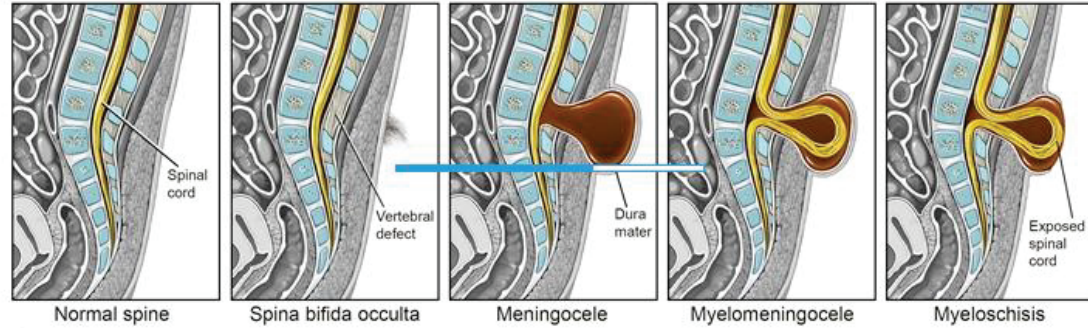
This patient with epilepsy controlled with **valproate** is at increased risk for fetal **neural tube defects**. Valproate, an antiepileptic agent also used to prevent migraine headache and treat bipolar disorder, is **contraindicated in pregnancy** because it interferes with folate metabolism and causes **maternal folate deficiency**. Folic acid is required to regulate fetal neural tube closure in early pregnancy; therefore, patients taking valproate are at increased risk for incomplete neural tube closure (eg, meningocele, [myelomeningocele](#)) compared to the general population.

Because most women discover that they are pregnant after the most vulnerable period of neural tube formation (eg, 4 weeks gestation), patients on valproate should try to optimize seizure control prior to conception with an **alternate anticonvulsant** (eg, levetiracetam). Low-dose **folic acid supplementation** is recommended in all women before conception; high-dose folic acid supplementation is recommended in the presence of risk factors such as current valproate use or a prior child with a neural tube defect.



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Spina bifida



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tube defect.

(Choices A and E) Epiphyseal stippling (pinpoint calcification) and nasal hypoplasia (depression of the nasal bridge) are characteristics of warfarin embryopathy caused by first-trimester exposure to warfarin.

(Choices B and G) Maternal hypothyroidism, neonatal hypothyroidism, and fetal tricuspid valve malformation (ie, [Ebstein anomaly](#)) are associated with lithium use during pregnancy. Neonatal hypothyroidism can also result from exposure to maternal antithyroid medications (eg, propylthiouracil, methimazole).

(Choice C) Micrognathia, or hypoplasia of the mandible, is a [craniofacial](#) malformation that can occur with fetal exposure to isotretinoin. It is also commonly associated with genetic syndromes (eg, [Trisomy 18](#)).

(Choice F) Renal dysgenesis and fetal anuria/oligohydramnios can result from the use of ACE inhibitors and angiotensin receptor blockers during pregnancy. These medications are contraindicated in pregnancy, but other antihypertensive medications such as nifedipine and labetalol are safe because they have no teratogenic effects.

Educational objective:

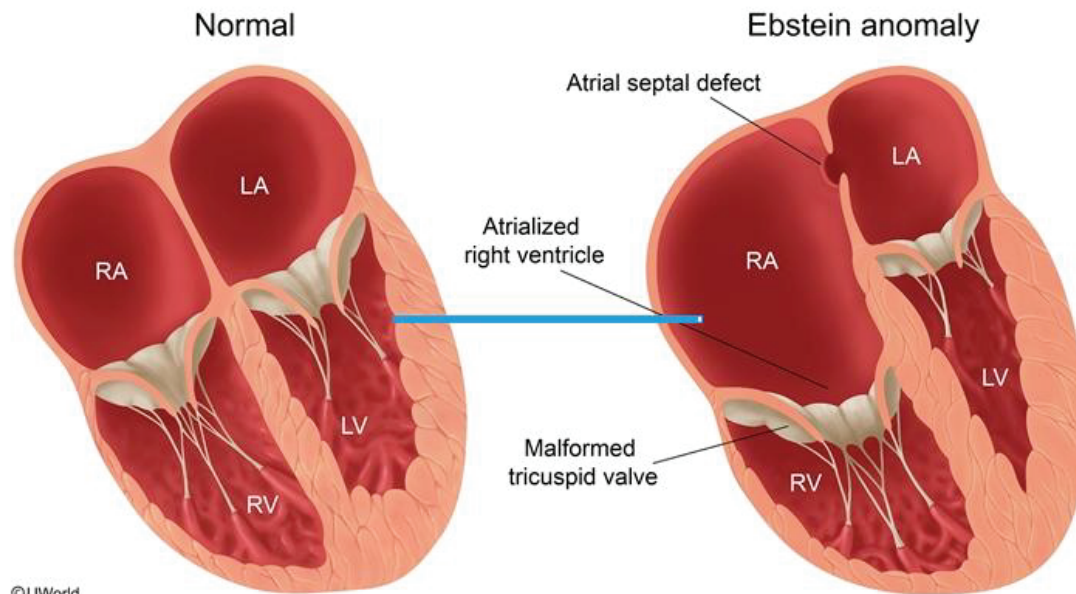
Valproate is a teratogenic medication that decreases maternal folate levels and increases the risk of fetal neural tube defects (eg, meningocele, myelomeningocele).





tube defect

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neural tube defects (e.g., meningocele, myelomeningocele).

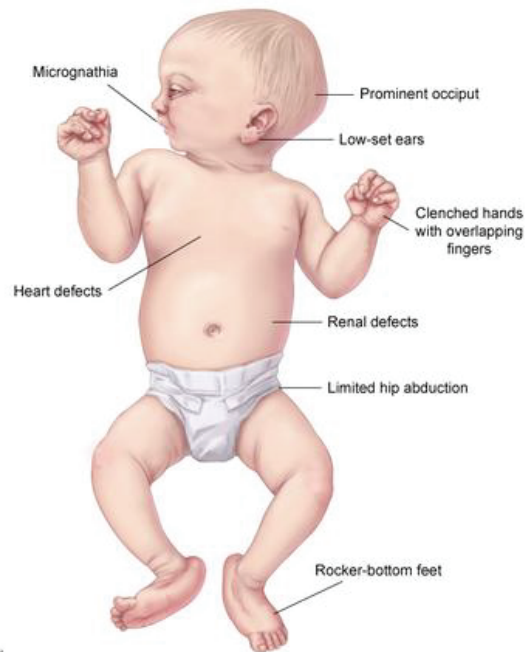




tube defect

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Trisomy 18 (Edwards syndrome)



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neural tube defects (e.g., meningocele, myelomeningocele).





A 28-year-old woman, gravida 2 para 1, at 18 weeks gestation comes to the office for a routine prenatal appointment. She is feeling well and has had no complications during this pregnancy. The patient has no chronic medical conditions and has had no previous surgeries. Her only medications are a daily prenatal vitamin and an iron supplement. Blood pressure is 110/70 mm Hg and pulse is 62/min. BMI is 24 kg/m². Cardiopulmonary examination is unremarkable. The uterus is consistent with 18 weeks gestation and fetal heart tones are normal. There is mild bilateral pedal edema to the shins. Compared to a nonpregnant state, which of the following changes are most likely expected in this patient?

	Fibrinogen level	Protein S level	Fibrinolysis activity
--	-----------------------------	----------------------------	----------------------------------

- | | | | |
|------------------------------------|---|-----------|---|
| <input type="radio"/> A. | ↓ | ↑ | ↑ |
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| <input type="radio"/> D. | ↑ | ↓ | ↓ |
| <input type="radio"/> E. No change | ↑ | ↑ | ↓ |





vitamin and an iron supplement. Blood pressure is 110/70 mm Hg and pulse is 62/min. BMI is 24 kg/m².

Cardiopulmonary examination is unremarkable. The uterus is consistent with 18 weeks gestation and fetal heart tones are normal. There is mild bilateral pedal edema to the shins. Compared to a nonpregnant state, which of the following changes are most likely expected in this patient?

	Fibrinogen level	Protein S level	Fibrinolysis activity
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- | | | | |
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| <input type="radio"/> D. | ↑ | ↓ | ↓ |
| <input type="radio"/> E. | No change | ↑ | ↓ |
| <input type="radio"/> F. | No change | ↓ | ↑ |

Submit

Physiologic changes of pregnancy

Cardiovascular	<ul style="list-style-type: none">• ↑ Blood volume (plasma > RBC mass)• ↓ Systemic vascular resistance• ↑ Heart rate & cardiac output
Pulmonary	<ul style="list-style-type: none">• ↑ Central respiratory drive (hyperventilation)• ↓ PaCO₂ (respiratory alkalosis), ↑ PaO₂
Renal	<ul style="list-style-type: none">• ↑ Renal blood flow & urine output• ↑ GFR, ↓ BUN & serum creatinine• ↑ HCO₃⁻ excretion (metabolic compensation)• ↓ Serum Na⁺ concentration (↑ ADH secretion)
Hematologic	<ul style="list-style-type: none">• ↑ Prothrombotic coagulation factors• ↓ Hemoglobin concentration (dilutional anemia)

ADH = antidiuretic hormone; **BUN** = blood urea nitrogen; **GFR** = glomerular filtration rate; **RBC** = red blood cell.

Normal pregnancy is associated with physiologic changes to the maternal clotting system in order to



Normal pregnancy is associated with physiologic changes to the maternal clotting system in order to adapt to pregnancy and prepare for delivery. In general, pregnancy is a mild **prothrombotic state** due to the following:

- **Increased procoagulant factors:** coagulation factors involved in the intrinsic (eg, factor XII), extrinsic (eg, factor VII), and final common (eg, **fibrinogen**) **pathways of clotting** are increased by up to 200%, which promotes the formation of cross-linked fibrin clots.
- **Decreased anticoagulant factors:** **protein S levels decrease** and resistance to activated protein C increases, leading to reduced clotting factor proteolysis.
- **Reduced fibrinolysis:** activity of fibrinolytic inhibitors (eg, plasminogen activator inhibitor-1 derived from the placenta) increases significantly, which reduces the breakdown of fibrin clots.

Although these changes protect against excessive maternal bleeding during fetal delivery and separation of the placenta, they also increase the risk of peripartum venous thromboembolism.

Educational objective:

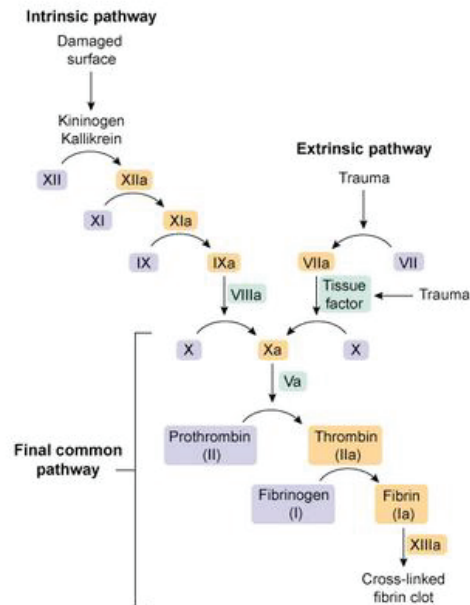
Pregnancy is a prothrombotic state due to increased procoagulant factors (eg, fibrinogen), decreased anticoagulant factors (eg, protein S), and reduced fibrinolysis. These physiologic changes protect against maternal hemorrhage with delivery but increase the risk of peripartum venous thromboembolism.

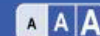




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Coagulation cascade pathway





(eg, factor VII), and final common (eg, **fibrinogen**) pathways of clotting are increased by up to 200%, which promotes the formation of cross-linked fibrin clots.

- Decreased anticoagulant factors: **protein S levels decrease** and resistance to activated protein C increases, leading to reduced clotting factor proteolysis.
- **Reduced fibrinolysis:** activity of fibrinolytic inhibitors (eg, plasminogen activator inhibitor-1 derived from the placenta) increases significantly, which reduces the breakdown of fibrin clots.

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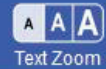
Educational objective:

Pregnancy is a prothrombotic state due to increased procoagulant factors (eg, fibrinogen), decreased anticoagulant factors (eg, protein S), and reduced fibrinolysis. These physiologic changes protect against maternal hemorrhage with delivery but increase the risk of peripartum venous thromboembolism.

References

- [Deep venous thrombosis in pregnancy: incidence, pathogenesis and endovascular management.](#)





A 23-year-old woman, gravida 1, para 0, comes to the office for a routine prenatal care visit. She is at 35 weeks gestation and feels well. She reports regular fetal movement and no contractions, loss of fluid, or vaginal bleeding. Pregnancy to date has been uncomplicated and the patient has no underlying medical conditions. She signed up for a clinical trial investigating prolactin. At 34 weeks gestation, she had a serum prolactin level several times higher than what was recorded prior to pregnancy. Which of the following hormones prevents lactation in this patient?

- ☐ A. β -hCG
- ☐ B. Insulin
- ☐ C. LH
- ☐ D. Progesterone
- ☐ E. Thyroxine

Submit





A 23-year-old woman, gravida 1, para 0, comes to the office for a routine prenatal care visit. She is at 35 weeks gestation and feels well. She reports regular fetal movement and no contractions, loss of fluid, or vaginal bleeding. Pregnancy to date has been uncomplicated and the patient has no underlying medical conditions. She signed up for a clinical trial investigating prolactin. At 34 weeks gestation, she had a serum prolactin level several times higher than what was recorded prior to pregnancy. Which of the following hormones prevents lactation in this patient?

- ☐ A. β -hCG (11%)
- ☐ B. Insulin (0%)
- ☐ C. LH (5%)
- ☒ D. Progesterone (80%)
- ☐ E. Thyroxine (3%)

Correct

80%
Answered correctly

11 secs
Time Spent

10/06/2020
Last Updated





Progesterone and estrogen promote normal development and maternal breast growth during the prenatal period. In the first trimester of pregnancy, progesterone is secreted by the **corpus luteum** and is crucial to successful implantation. In the second and third trimesters, progesterone is produced by the **placenta** and suppresses **FSH and LH** through action on the anterior pituitary (**Choice C**).

Prolactin is a peptide hormone that promotes lactogenesis (ie, maturation of breast alveolar cells) and **milk production**. It is released by the anterior pituitary gland due to stimulation by thyrotropin-releasing hormone (TRH) and increases steadily in circulation as pregnancy progresses. Although lactogenesis may begin during the second trimester, lactation is **suppressed** due to the high **progesterone** levels inhibiting the binding of prolactin to receptors on breast alveolar cells. After delivery, the precipitous drop in progesterone allows prolactin to stimulate lactation.

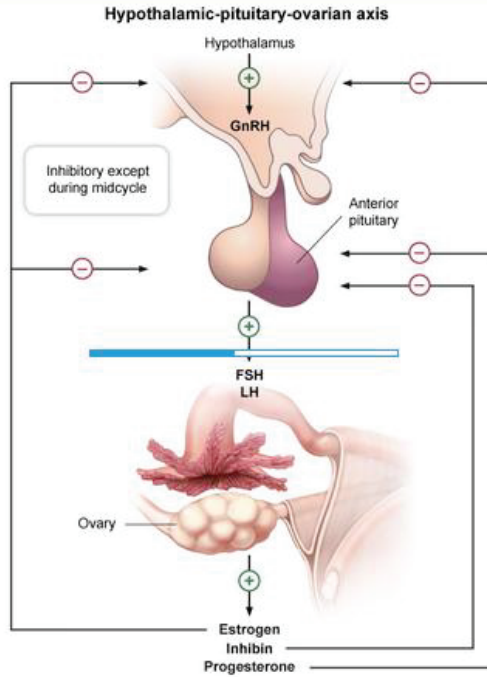
(**Choice A**) β -hCG is secreted by the embryonic **syncytiotrophoblast** during the first trimester, rising to its highest levels at the ninth week of gestation. β -hCG serves to maintain the corpus luteum until the placenta can assume responsibility for estrogen and progesterone synthesis. By mid-pregnancy, the corpus luteum degenerates and serum β -hCG decreases to a very low level. Therefore, β -hCG is not likely to have a significant effect on lactation during late pregnancy.

(**Choices B and E**) Thyroxine and insulin contribute to normal gestational mammary gland hypertrophy.



Progesterone and estrogen promote normal development and maternal breast growth during the prenatal

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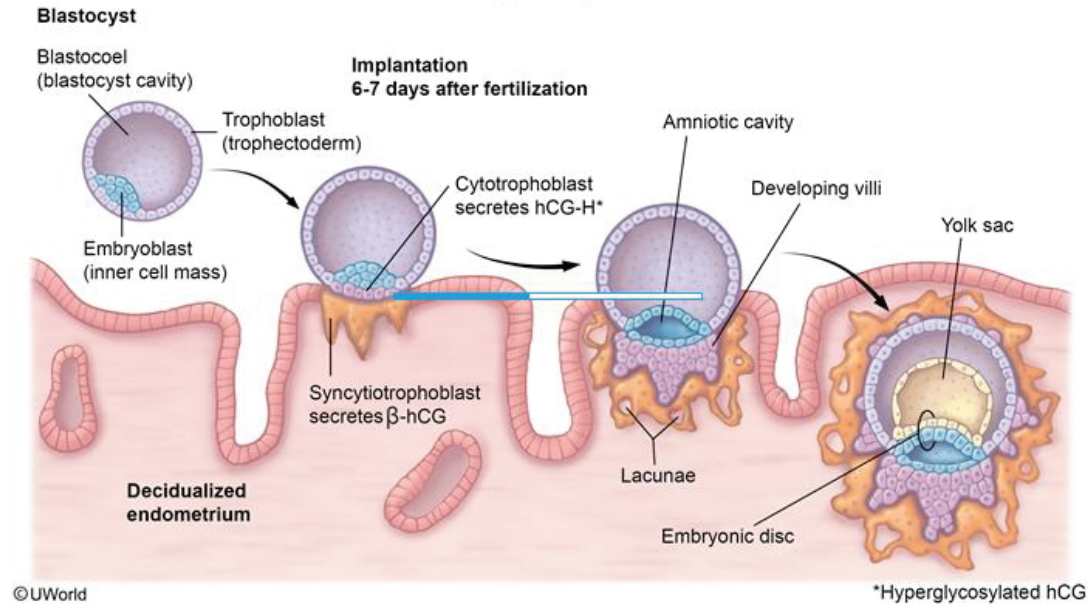
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Progesterone and estrogen promote normal development and maternal breast growth during the prenatal

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Blastocyst implantation



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placenta can assume responsibility for estrogen and progesterone synthesis. By mid-pregnancy, the corpus luteum degenerates and serum β -hCG decreases to a very low level. Therefore, β -hCG is not likely to have a significant effect on lactation during late pregnancy.

(Choices B and E) Thyroxine and insulin contribute to normal gestational mammary gland hypertrophy. Although high dose thyroxine can decrease the production of TRH, this patient has an elevated prolactin level which indicates that TRH production is not suppressed.

Educational objective:

In pregnancy, progesterone is secreted by the corpus luteum and later by the placenta. Although prolactin secretion increases as pregnancy progresses, high progesterone levels inhibit lactation by preventing binding of prolactin to receptors on alveolar cells in the breast.

References

- [Prolactin secretion patterns: basic mechanisms and clinical implications for reproduction](#)

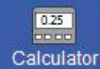
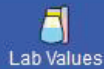
Physiology
Subject

Pregnancy, Childbirth & Puerperium
System

Normal pregnancy
Topic

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A 38-year-old woman, gravida 1 para 0, at 32 weeks gestation comes to the office due to a progressively worsening headache. The patient also reports increased leg swelling and a 4.54-kg (10-lb) weight gain since her last visit 2 weeks ago. She has no chronic medical conditions, and her pregnancy has been uncomplicated. Review of medical records shows that blood pressure was 130/80 mm Hg at 30 weeks gestation. Today, blood pressure is 165/100 mm Hg. There is 2+ pitting edema to the knees. Serum creatinine is 0.9 mg/dL. Which of the following findings would most likely be present in this patient's urinalysis?

- | | Specific gravity | Protein | Red blood cells |
|--------------------------|-------------------------|----------------|------------------------|
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| <input type="radio"/> B. | Decreased | + | None |
| <input type="radio"/> C. | Increased | None | + |
| <input type="radio"/> D. | Increased | + | None |
| <input type="radio"/> E. | Normal | None | + |





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uncomplicated. Review of medical records shows that blood pressure was 130/80 mm Hg at 30 weeks gestation. Today, blood pressure is 165/100 mm Hg. There is 2+ pitting edema to the knees. Serum creatinine is 0.9 mg/dL. Which of the following findings would most likely be present in this patient's urinalysis?

- | | Specific gravity | Protein | Red blood cells |
|--------------------------|------------------|---------|-----------------|
| <input type="radio"/> A. | Decreased | None | None |
| <input type="radio"/> B. | Decreased | + | None |
| <input type="radio"/> C. | Increased | None | + |
| <input type="radio"/> D. | Increased | + | None |
| <input type="radio"/> E. | Normal | None | + |
| <input type="radio"/> F. | Normal | + | + |

Submit

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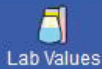
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End Block

uncomplicated. Review of medical records shows that blood pressure was 150/80 mm Hg at 30 weeks gestation. Today, blood pressure is 165/100 mm Hg. There is 2+ pitting edema to the knees. Serum creatinine is 0.9 mg/dL. Which of the following findings would most likely be present in this patient's urinalysis?

	Specific gravity	Protein	Red blood cells	
<input type="radio"/> A.	Decreased	None	None	(4%)
<input type="radio"/> B.	Decreased	+	None	(16%)
<input type="radio"/> C.	Increased	None	±	(1%)
<input checked="" type="radio"/> D.	Increased	+	None	(67%)
<input type="radio"/> E.	Normal	None	±	(0%)
<input type="radio"/> F.	Normal	±	±	(8%)



Hypertensive disorders of pregnancy

Chronic hypertension	<ul style="list-style-type: none">Systolic pressure ≥ 140 mm Hg &/or diastolic pressure ≥ 90 mm Hg prior to conception or 20 weeks gestation
Gestational hypertension	<ul style="list-style-type: none">New-onset elevated blood pressure at ≥ 20 weeks gestationNo proteinuria or end-organ damage
Preeclampsia	<ul style="list-style-type: none">New-onset elevated blood pressure at ≥ 20 weeks gestation AND <ul style="list-style-type: none">Proteinuria OR signs of end-organ damage
Eclampsia	<ul style="list-style-type: none">Preeclampsia AND <ul style="list-style-type: none">New-onset grand mal seizures

This patient with a worsening headache and **new-onset hypertension** (ie, systolic ≥ 140 or diastolic ≥ 90 mm Hg) **after 20 weeks gestation** has preeclampsia. **Preeclampsia** is most likely caused by narrowed uteroplacental spiral artery formation and abnormal placentation, which lead to placental hypoperfusion and





This patient with a worsening headache and **new-onset hypertension** (ie, systolic ≥ 140 or diastolic ≥ 90 mm Hg) **after 20 weeks gestation** has preeclampsia. **Preeclampsia** is most likely caused by narrowed uteroplacental spiral artery formation and abnormal placentation, which lead to placental hypoperfusion and ischemia. These changes trigger the release of antiangiogenic factors that cause widespread maternal vasoconstriction (eg, hypertension), endothelial cell damage (eg, third spacing with edema and weight gain), and **end-organ damage** (eg, headache).

The kidneys are commonly affected by preeclampsia, and **urinalysis** can support the diagnosis:

- Third spacing (ie, intravascular volume depletion) and vasoconstriction of the renal vessels result in decreased urine production (ie, oliguria) and concentrated urine (ie, **increased specific gravity**) because the kidneys attempt to retain sodium and water.
- Damage to the renal endothelium increases glomerular permeability and allows for leakage of large molecules, as evidenced by **proteinuria**, which is classic for preeclampsia.
- Renal vasoconstriction causes a decreased glomerular filtration rate (GFR) and an **increased serum creatinine level** (above baseline). Healthy pregnant patients have decreased baseline serum creatinine levels due to blood volume expansion and increased GFR; therefore, a normal-appearing creatinine level (0.7-0.9 mg/dL) during pregnancy, as seen in this patient, typically indicates renal





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creatinine level (above baseline). Healthy pregnant patients have decreased baseline serum

creatinine levels due to blood volume expansion and increased GFR; therefore, a normal-appearing creatinine level (0.7-0.9 mg/dL) during pregnancy, as seen in this patient, typically indicates renal compromise.

Definitive management of preeclampsia is with delivery, and renal function typically recovers postpartum.

(Choices A and B) Decreased urine specific gravity (ie, decreased concentration of urine solutes) is associated with excessive fluid intake (eg, primary polydipsia) or diabetes insipidus. It is not associated with hypertension in pregnancy.

(Choices C, E, and F) Microscopic hematuria (ie, red blood cells on urinalysis) is typically associated with urinary tract disease, such as infection, kidney or bladder cancer, and renal calculus. Hematuria is not associated with hypertension in pregnancy.

Educational objective:

Preeclampsia is new-onset hypertension after 20 weeks gestation with signs of end-organ damage (eg, headache). Renal effects of preeclampsia include oliguria with increased specific gravity, proteinuria, and serum creatinine levels.

References





A 24-year-old woman, gravida 1 para 0, at 28 weeks gestation comes to the office for a routine prenatal visit. She feels well and has had no vaginal bleeding, contractions, or leakage of fluid. Fetal movement is normal. The patient has no chronic medical conditions and her pregnancy has been uncomplicated. She previously had heavy menstrual periods that were managed with oral contraceptives. Blood pressure is 126/84 mm Hg and pulse is 78/min. Fundal height and fetal heart tones are normal. Today's third-trimester complete blood count is as follows:

Hemoglobin 11.2 g/dL

Platelets 120,000/mm³

Leukocytes 8,200/mm³

Coagulation studies and peripheral smear are within normal limits. The patient's first-trimester platelet count was 160,000/mm³. Urine dipstick today is negative for protein. Which of the following is the most likely cause of this patient's thrombocytopenia?

- ☐ A. Coagulation cascade–activated thrombi formation
- ☐ B. Decreased thromboxane A₂ production





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Hemoglobin 11.2 g/dL

Platelets 120,000/mm³Leukocytes 8,200/mm³

Coagulation studies and peripheral smear are within normal limits. The patient's first-trimester platelet count was 160,000/mm³. Urine dipstick today is negative for protein. Which of the following is the most likely cause of this patient's thrombocytopenia?

- ☐ A. Coagulation cascade–activated thrombi formation
- ☐ B. Decreased thromboxane A₂ production
- ☐ C. Hemodilution and increased platelet sequestration
- ☐ D. Immune complex–mediated complement activation
- ☐ E. Small vessel formation of platelet microthrombi

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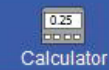
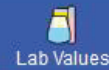
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Hemoglobin 11.2 g/dL

Platelets 120,000/mm³

Leukocytes 8,200/mm³

Coagulation studies and peripheral smear are within normal limits. The patient's first-trimester platelet count was 160,000/mm³. Urine dipstick today is negative for protein. Which of the following is the most likely cause of this patient's thrombocytopenia?

- ☐ A. Coagulation cascade-activated thrombi formation (7%)
- ☐ B. Decreased thromboxane A₂ production (4%)
- ☒ C. Hemodilution and increased platelet sequestration (78%)
- ☐ D. Immune complex-mediated complement activation (4%)
- ☐ E. Small vessel formation of platelet microthrombi (5%)

Correct



78%



01 min, 39 secs

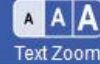
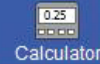
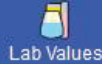
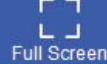


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This patient at 28 weeks gestation has mild, asymptomatic thrombocytopenia most consistent with **gestational thrombocytopenia** (GT), a benign, self-limited condition that can occur during pregnancy. GT is thought to arise due to the following:

- **Plasma volume expansion:** Maternal plasma volume expands approximately 30% during pregnancy to facilitate optimal fetal nutrient delivery and protect against maternal hemorrhage during delivery. Platelet production, however, does not typically increase during pregnancy; therefore, there is **hemodilution** and resultant thrombocytopenia.
- **Sequestration/consumption of platelets** in the placenta: The placenta is a highly vascular organ with similarities to the spleen, a major site of normal platelet sequestration. Platelets pool in the placental circulation and undergo accelerated consumption within the intervillous space, thereby reducing the serum platelet count.

GT is commonly diagnosed in the **third trimester**, when plasma volume peaks; it is often an incidental finding on routine bloodwork. Patients with GT have mild thrombocytopenia (platelet count usually $\geq 100,000/\text{mm}^3$), no symptoms (eg, no bruising or bleeding), normal coagulation studies, and normal peripheral blood smear.

(Choice A) Disseminated intravascular coagulation (DIC) is characterized by widespread activation of the





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(Choice A) Disseminated intravascular coagulation (DIC) is characterized by widespread activation of the coagulation cascade with thrombocytopenia due to platelet consumption. However, DIC is associated with bleeding and abnormal coagulation studies, which are not seen in this patient.

(Choice B) Aspirin decreases the production of thromboxane A₂ and inhibits platelet aggregation. Patients taking aspirin usually have normal or elevated platelet counts and decreased platelet clotting function.

(Choice D) Immune complex-mediated complement activation occurs in inflammatory rheumatologic diseases (eg, systemic lupus erythematosus). Although these conditions are often associated with thrombocytopenia, patients typically have other symptoms.

(Choice E) Thrombotic thrombocytopenic purpura (TTP) causes thrombocytopenia due to the formation of platelet clots in the microvasculature. However, TTP typically causes fever, microangiopathic hemolytic anemia, and neurologic abnormalities.

Educational objective:

Gestational thrombocytopenia is common in the third trimester and is typically mild, asymptomatic, and not associated with other laboratory abnormalities. It occurs due to hemodilution (ie, maternal plasma volume expansion) and increased sequestration/consumption of platelets in the placenta.



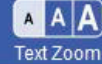
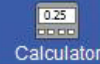
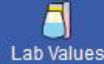
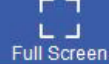
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End Block



An 18-year-old primigravida at 27 weeks gestation comes to the emergency department due to severe right upper quadrant pain. The pain started 2 hours ago, and the patient has also had nausea, vomiting, and irregular uterine contractions. Temperature is 36.7 C (98.1 F), blood pressure is 172/118 mm Hg, and pulse is 110/min. BMI is 34 kg/m². On abdominal examination, tenderness to palpation is present over the right upper quadrant. Aspartate aminotransferase (SGOT) is 220 U/L and alanine aminotransferase (SGPT) is 240 U/L. Abdominal imaging reveals a hepatic subcapsular hematoma. This patient is most at risk for which of the following complications?

- ☐ A. Acute interstitial nephritis
- ☐ B. Bleeding esophageal varices
- ☐ C. Intraamniotic infection
- ☐ D. Pancreatitis
- ☐ E. Seizures
- ☐ F. Thrombocytosis





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upper quadrant pain. The pain started 2 hours ago, and the patient has also had nausea, vomiting, and irregular uterine contractions. Temperature is 36.7 C (98.1 F), **blood pressure** is 172/118 mm Hg, and pulse is 110/min. BMI is 34 kg/m². On abdominal examination, tenderness to palpation is present over the right upper quadrant. Aspartate aminotransferase (SGOT) is 220 U/L and alanine aminotransferase (SGPT) is 240 U/L. Abdominal imaging reveals a hepatic subcapsular **hematoma**. This patient is most at risk for which of the following complications?

- ☐ A. Acute interstitial nephritis (1%)
- ☐ B. Bleeding esophageal varices (11%)
- ☐ C. Intraamniotic infection (6%)
- ☐ D. Pancreatitis (5%)
- ☒ E. Seizures (55%)
- ☐ F. Thrombocytosis (19%)

Incorrect

Correct answer

55%

01 min, 38 secs

11/05/2020

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This pregnant patient with **hypertension** and right upper quadrant pain likely has **preeclampsia with severe features** (ie, new hypertension at >20 weeks gestation with signs of severe end-organ damage) and/or **HELLP** (**H**emolysis, **E**levated **L**iver enzymes, **L**ow **P**latelet count) **syndrome**. Both conditions share common features and likely represent a spectrum of disease; they are characterized by widespread endothelial dysfunction that leads to dysregulated vascular tone (eg, hypertension), increased vessel permeability (eg, proteinuria), and **end-organ vasospasm**. Patients with HELLP syndrome also have platelet overactivation with widespread deposition of platelet-fibrin microthrombi within capillaries.

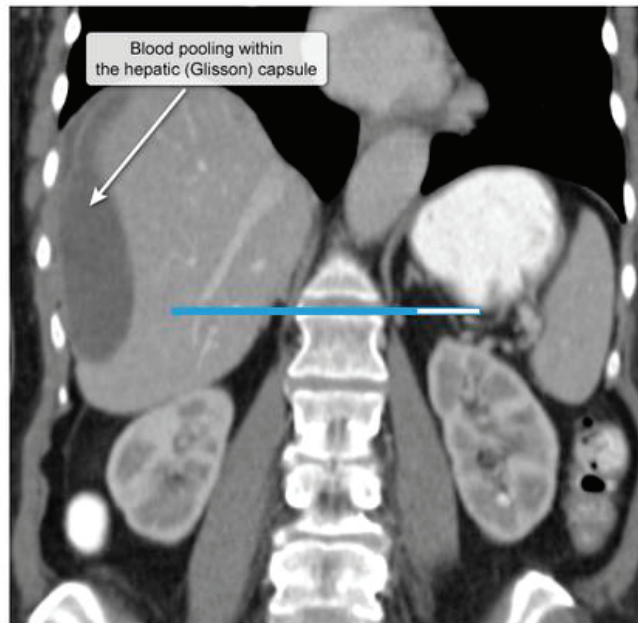
Both vasospasm and microthrombi deposition result in decreased hepatic blood flow, liver ischemia, and **hepatocellular injury** (eg, nausea, vomiting, right upper quadrant pain, elevated transaminases). Severe cases may progress to liver necrosis and hemorrhage, causing a **subcapsular hematoma** (ie, **blood pooling** beneath the hepatic [Glisson] capsule with capsular distension).

Because preeclampsia and HELLP syndrome cause widespread endothelial dysfunction and vasospasm, multiple organ systems are affected, and patients are at increased risk for other complications. These include **seizures** (due to cerebral vasospasm, thrombosis, and/or edema); renal insufficiency (due to **intrarenal vasospasm**); thrombocytopenia; and disseminated intravascular coagulation (due to overactivation of the coagulation cascade) (**Choice F**).



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Subcapsular hematoma



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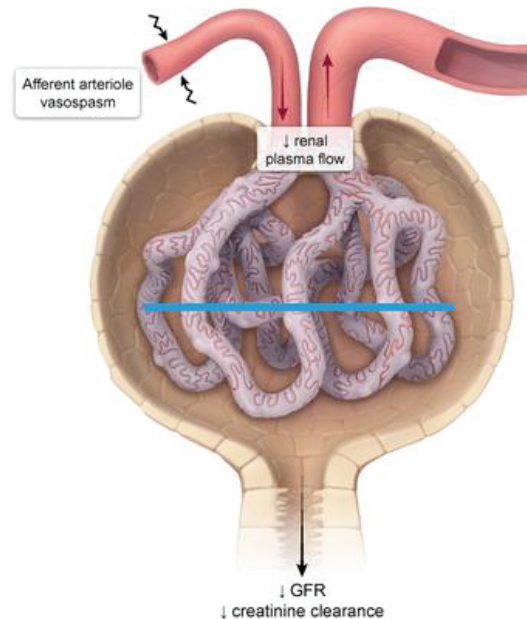
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Intrarenal artery vasospasm



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overactivation of the coagulation cascade) (Choice F).

(Choice A) Although this patient is at risk for renal insufficiency, she is not at increased risk for acute interstitial nephritis, which is typically drug induced (eg, nonsteroidal anti-inflammatory drugs).

(Choice B) Bleeding esophageal varices typically occur in patients with liver cirrhosis due to venous portal hypertension. In contrast, HELLP syndrome and preeclampsia cause arterial hypertension.

(Choice C) The risk for intraamniotic infection is increased with prolonged rupture of membranes or genitourinary infection (eg, group B *Streptococcus*, *Chlamydia trachomatis*).

(Choice D) Risk factors for pancreatitis include biliary disease, alcohol abuse, and hypertriglyceridemia.

Educational objective:

Pregnant women with severe preeclampsia can develop HELLP (Hemolysis, Elevated Liver enzymes, Low Platelet count) syndrome. Nausea/vomiting and right upper quadrant pain occur due to liver ischemia and/or hemorrhage (eg, subcapsular hematoma). These patients are also at risk for seizure, renal insufficiency, and disseminated intravascular coagulation due to widespread endothelial dysfunction.

Anatomy

Pregnancy, Childbirth & Puerperium

Preeclampsia

Subject

System

Topic

A 31-year-old woman, gravida 3 para 2, at 28 weeks gestation comes to the office for a prenatal visit. She has chronic hypertension that has been well controlled during this pregnancy. At the patient's previous prenatal visits, her blood pressure ranged from 120/70 to 130/80 mm Hg. Today, her blood pressure is 150/100 mm Hg and repeat is 152/98 mm Hg. Fundal height is 24 cm. Urinalysis shows 2+ protein. A transabdominal ultrasound reveals oligohydramnios and a fetus with growth restriction. Compared to normal placental parameters, this patient most likely has which of the following hemodynamic changes?

	Placental vascular resistance	Uteroplacental perfusion	Umbilical vein oxygen delivery
<input type="radio"/> A.	↓	↓	↑
<input type="radio"/> B.	↓	↑	↑
<input type="radio"/> C.	No change	↓	↓
<input type="radio"/> D.	↑	↓	No change
<input type="radio"/> E.	↑	↓	↑
<input type="radio"/> F.	↑	↓	↓

has chronic hypertension that has been well controlled during this pregnancy. At the patient's previous prenatal visits, her blood pressure ranged from 120/70 to 130/80 mm Hg. Today, her blood pressure is 150/100 mm Hg and repeat is 152/98 mm Hg. Fundal height is 24 cm. Urinalysis shows 2+ protein. A transabdominal ultrasound reveals oligohydramnios and a fetus with growth restriction. Compared to normal placental parameters, this patient most likely has which of the following hemodynamic changes?

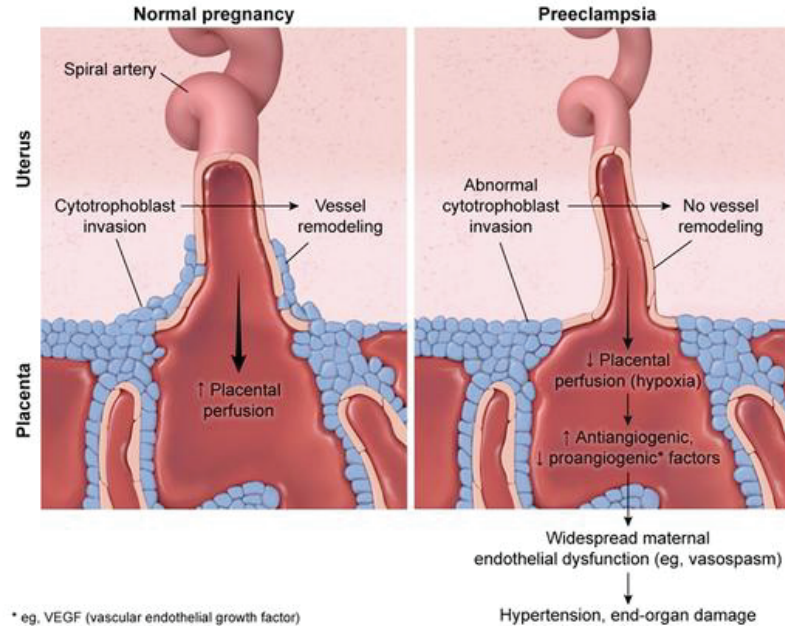
	Placental vascular resistance	Uteroplacental perfusion	Umbilical vein oxygen delivery
<input type="radio"/> A.	↓	↓	↑
<input type="radio"/> B.	↓	↑	↑
<input type="radio"/> C.	No change	↓	↓
<input type="radio"/> D.	↑	↓	No change
<input type="radio"/> E.	↑	↓	↑
<input type="radio"/> F.	↑	↓	↓

has **chronic hypertension** that has been well controlled during this pregnancy. At the patient's previous prenatal visits, her blood pressure ranged from 120/70 to 130/80 mm Hg. Today, her **blood pressure** is 150/100 mm Hg and repeat is 152/98 mm Hg. Fundal height is 24 cm. Urinalysis shows 2+ protein. A transabdominal ultrasound reveals **oligohydramnios** and a fetus with **growth restriction**. Compared to normal placental parameters, this patient most likely has which of the following hemodynamic changes?

	Placental vascular resistance	Uteroplacental perfusion	Umbilical vein oxygen delivery	
<input type="radio"/> A.	↓	↓	↑	(1%)
<input type="radio"/> B.	↓	↑	↑	(1%)
<input type="radio"/> C.	No change	↓	↓	(4%)
<input type="radio"/> D.	↑	↓	No change	(16%)
<input type="radio"/> E.	↑	↓	↑	(2%)
<input checked="" type="radio"/> F.	↑	↓	↓	(72%)

Exhibit Display

Pathogenesis of preeclampsia



* eg, VEGF (vascular endothelial growth factor)
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This pregnant patient at ≥ 20 weeks gestation with hypertension (defined during pregnancy as systolic ≥ 140 mm Hg or diastolic ≥ 90 mm Hg) and proteinuria has **preeclampsia**. Risk factors include chronic hypertension or maternal vascular diseases (eg, diabetes mellitus, systemic lupus erythematosus).

Preeclampsia is thought to occur due to abnormal development of placental cytotrophoblasts and the spiral arteries, which provide blood supply to the fetus and placenta. In healthy pregnancies, cytotrophoblasts act on the endothelial and muscular layers of the spiral arteries, changing the spiral arteries from small, tortuous vessels to high capacitance, low resistance vessels. These changes allow for increased uteroplacental perfusion and preferential supply of blood to the fetus for growth and development.

However, in patients with preeclampsia, spiral arteries remain narrow and tortuous, resulting in **high placental vascular resistance**. This subsequently leads to **decreased uteroplacental perfusion**. As a result, the placenta cannot deliver adequate volumes of oxygenated blood to the fetus (ie, **decreased umbilical vein oxygen delivery**). The fetal response to inadequate oxygenation is to slow its growth (ie, **fetal growth restriction**) and preferentially shunt blood from the periphery (eg, kidneys) to the brain, leading to decreased fetal urine output and **oligohydramnios**, as seen in this patient.

Educational objective:

Patients with preeclampsia are at risk for fetal growth restriction and oligohydramnios due to abnormal

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uteroplacental perfusion and preferential supply of blood to the fetus for growth and development.

However, in patients with preeclampsia, spiral arteries remain narrow and tortuous, resulting in **high placental vascular resistance**. This subsequently leads to **decreased uteroplacental perfusion**. As a result, the placenta cannot deliver adequate volumes of oxygenated blood to the fetus (ie, **decreased umbilical vein oxygen delivery**). The fetal response to inadequate oxygenation is to slow its growth (ie, **fetal growth restriction**) and preferentially shunt blood from the periphery (eg, kidneys) to the brain, leading to decreased fetal urine output and **oligohydramnios**, as seen in this patient.

Educational objective:

Patients with preeclampsia are at risk for fetal growth restriction and oligohydramnios due to abnormal placental spiral artery development, which leads to increased placental vascular resistance, decreased uteroplacental perfusion, and decreased umbilical vein oxygen delivery.

References

- [Mechanisms of endothelial dysfunction in hypertensive pregnancy and preeclampsia.](#)

Pathology

Pregnancy, Childbirth & Puerperium

Preeclampsia

Subject

System

Topic





A 24-year-old primigravid woman at 36 weeks gestation comes to the physician complaining of lightheadedness and nausea at bedtime. Her pregnancy has been uncomplicated and her past medical history is unremarkable. She takes one multivitamin and one iron tablet daily. Her blood pressure is 115/75 mm Hg when sitting, 110/70 mm Hg when standing, and 80/60 mm Hg when supine. Physical examination shows a uterus consistent in size with 36 weeks gestation. Which of the following is the most likely explanation for this patient's hypotension while supine?

- ☐ A. Autonomic neuropathy
- ☐ B. Decreased venous return
- ☐ C. Reduced peripheral arterial resistance
- ☐ D. Volume depletion
- ☐ E. Withdrawal of sympathetic activity

Submit



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A 24-year-old primigravid woman at 36 weeks gestation comes to the physician complaining of lightheadedness and nausea at bedtime. Her pregnancy has been uncomplicated and her past medical history is unremarkable. She takes one multivitamin and one iron tablet daily. Her blood pressure is 115/75 mm Hg when sitting, 110/70 mm Hg when standing, and 80/60 mm Hg when supine. Physical examination shows a uterus consistent in size with 36 weeks gestation. Which of the following is the most likely explanation for this patient's hypotension while supine?

- ☐ A. Autonomic neuropathy (1%)
- ☒ B. Decreased venous return (75%)
- ☐ C. Reduced peripheral arterial resistance (12%)
- ☐ D. Volume depletion (2%)
- ☐ E. Withdrawal of sympathetic activity (8%)

Correct

 75%
Answered correctly 16 secs
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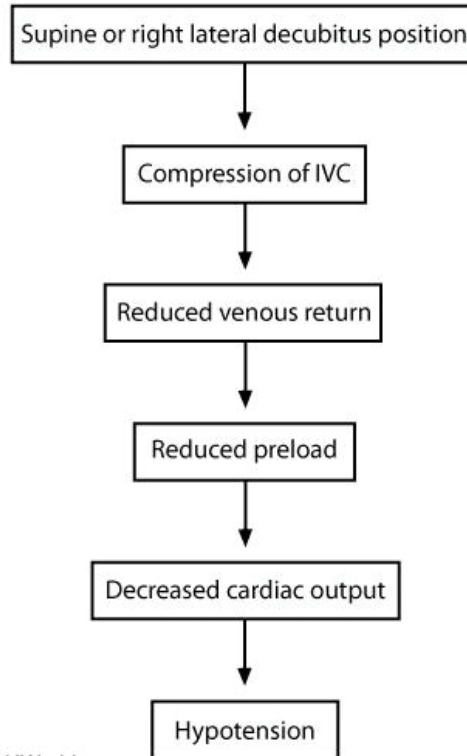


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Supine hypotension syndrome



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Supine hypotension syndrome (or aortocaval compression syndrome) is characterized by hypotension, pallor, sweating, nausea, and dizziness that occur when a pregnant woman lies supine (on her back). Symptoms resolve with sitting, standing up, or when assuming a left lateral decubitus position. It occurs predominantly in women > 20 weeks gestation, and is due to the gravid uterus compressing and obstructing the inferior vena cava. This reduces the venous return (preload), which subsequently lowers the cardiac output leading to hypotension. In severe cases, it can result in loss of consciousness and even fetal demise.

(Choice A) Peripheral neuropathies that affect postganglionic autonomic nerves can result in orthostatic hypotension. Diabetes mellitus is the most common cause of autonomic neuropathy in developed countries.

(Choice C) The blood pressure falls early in gestation, secondary to a reduction in systemic vascular resistance. However, this would not result in isolated supine hypotension.

(Choice D) During pregnancy, there is expansion of the plasma volume and an increase in red blood cell mass. In addition, volume depletion is more likely to cause orthostatic hypotension than supine hypotension.





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(Choice C) The blood pressure falls early in gestation, secondary to a reduction in systemic vascular resistance. However, this would not result in isolated supine hypotension.

(Choice D) During pregnancy, there is expansion of the plasma volume and an increase in red blood cell mass. In addition, volume depletion is more likely to cause orthostatic hypotension than supine hypotension.

(Choice E) Vasovagal syncope occurs due to concomitant withdrawal of sympathetic efferent activity and enhanced parasympathetic (vagal) activity, which results in bradycardia, vasodilation, and orthostatic hypotension.

Educational objective:

Pregnant women > 20 weeks gestation can experience compression of the inferior cava by the gravid uterus while in the supine position. This reduces venous return and cardiac output, which can result in hypotension and syncope.

References

- [Supine hypotensive syndrome.](#)

Physiology

Pregnancy, Childbirth & Puerperium

Supine hypotension

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A 25-year-old primigravida at 37 weeks gestation is brought to the emergency department with constant, excruciating abdominal pain and sudden vaginal bleeding for the past 3 hours. The patient is Rh negative and received Rh(D) immunoglobulin at 28 weeks gestation. She has no chronic medical conditions and takes no medications. Blood pressure is 160/100 mm Hg and pulse is 118/min. Physical examination shows a firm and tender uterus. Speculum examination reveals a moderate amount of bleeding coming from an open cervical os. Fetal heart tracing shows a baseline of 105/min and no variability. Which of the following is the most likely cause of this patient's bleeding?

- ☐ A. Attachment of the placenta onto the myometrium
- ☐ B. Full-thickness disruption of the uterine wall
- ☐ C. Injury to the fetal placental vessels
- ☐ D. Placental implantation over the cervix
- ☐ E. Premature placental separation

Submit

A 25-year-old primigravida at 37 weeks gestation is brought to the emergency department with constant, excruciating abdominal pain and sudden vaginal bleeding for the past 3 hours. The patient is Rh negative and received Rh(D) immunoglobulin at 28 weeks gestation. She has no chronic medical conditions and takes no medications. Blood pressure is 160/100 mm Hg and pulse is 118/min. Physical examination shows a firm and tender uterus. Speculum examination reveals a moderate amount of bleeding coming from an open cervical os. Fetal heart tracing shows a baseline of 105/min and no variability. Which of the following is the most likely cause of this patient's bleeding?

- ☐ A. Attachment of the placenta onto the myometrium (6%)
- ☐ B. Full-thickness disruption of the uterine wall (3%)
- ☐ C. Injury to the fetal-placental vessels (6%)
- ☐ D. Placental implantation over the cervix (16%)
- ☒ E. Premature placental separation (66%)

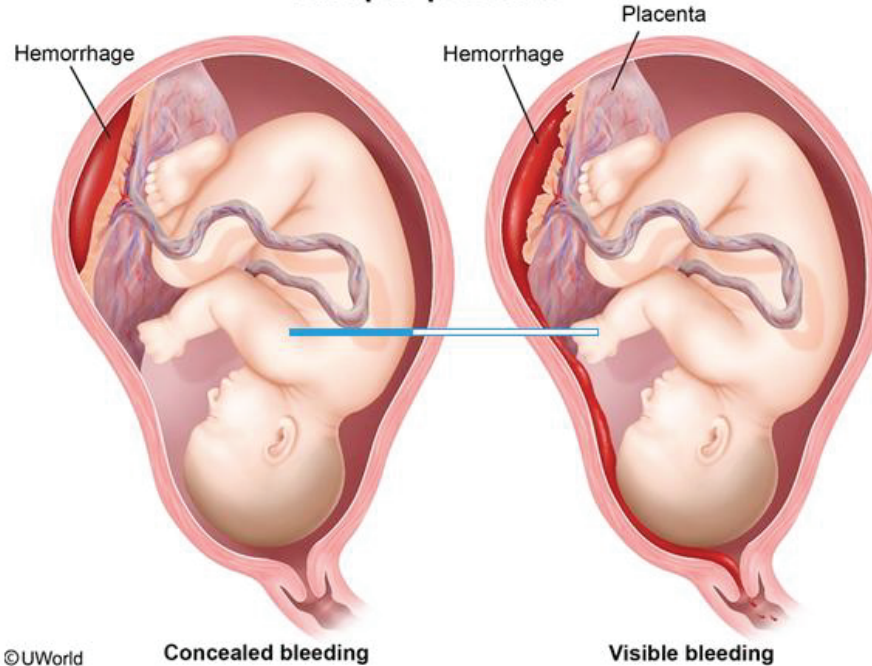
Abruptio placentae

Definition	<ul style="list-style-type: none">• Premature placental separation from uterus
Risk factors	<ul style="list-style-type: none">• Hypertension, preeclampsia• Abdominal trauma• Cocaine or tobacco use• Prior abruptio placentae
Clinical features	<ul style="list-style-type: none">• Sudden-onset vaginal bleeding• Abdominal pain• High-frequency contractions• Tender, firm uterus

This patient in the third trimester with **painful vaginal bleeding** and a **tender, firm uterus** has a presentation consistent with **abruptio placentae** (ie, premature separation of the placenta from the uterus prior to fetal delivery). **Abruptio placentae** is associated with **maternal hypertension**, abdominal trauma, use of tobacco or cocaine (vasoconstrictors causing placental ischemia), and prior abruptio placentae.

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Abruptio placentae



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Concealed bleeding

Visible bleeding

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presentation consistent with **abruptio placentae** (ie, premature separation of the placenta from the uterus prior to fetal delivery). **Abruptio placentae** is associated with **maternal hypertension**, abdominal trauma, use of tobacco or cocaine (vasoconstrictors causing placental ischemia), and prior abruptio placentae.

Abruptio placentae occurs when maternal **vessels rupture at the uteroplacental interface**, causing intrauterine bleeding. This bleeding results in **detachment of the placenta** from the uterus, an increase in intrauterine pressure (eg, tender, distended uterus), and **uterine irritability** (eg, high-frequency, low-intensity contractions).

Some cases are self-limiting and contained, whereas others progress as the bleeding and placental separation continue. As the degree of placental separation increases, the risk of **fetal compromise** and mortality from hypoxia (eg, fetal bradycardia, minimal variability in the fetal heart rate tracing) also increases. Maternal complications include hemorrhage and **disseminated intravascular coagulation**. Acute abruptio placentae with active bleeding is an indication for delivery; the mode of delivery depends on both maternal and fetal stability.

(Choice A) **Placenta accreta**, direct attachment of the placental villi onto the myometrium, typically presents after delivery of the fetus with postpartum hemorrhage and inability to remove the placenta.

(Choice B) **Uterine rupture**, full-thickness disruption of the uterine wall, is associated with severe lower





both maternal and fetal stability.

(Choice A) **Placenta accreta**, direct attachment of the placental villi onto the myometrium, typically presents after delivery of the fetus with postpartum hemorrhage and inability to remove the placenta.

(Choice B) **Uterine rupture**, full-thickness disruption of the uterine wall, is associated with severe lower abdominal pain, vaginal bleeding, and fetal heart rate tracing abnormalities (eg, bradycardia). However, it typically occurs in patients with prior cesarean delivery (this patient is a primigravida) and typically has a uterus with palpable fetal parts, rather than uterine rigidity.

(Choice C) In **vasa previa**, the fetal vessels traverse the internal cervical os and are vulnerable to injury. However, patients typically have painless, rather than painful, vaginal bleeding.

(Choice D) **Placenta previa**, placental implantation over the cervix, typically presents in the third trimester with painless, rather than painful, vaginal bleeding and no uterine tenderness.

Educational objective:

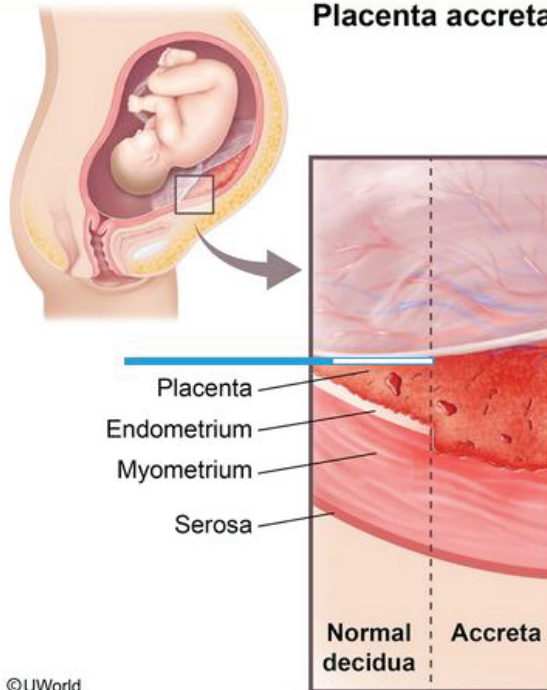
Abruptio placentae, detachment of the placenta from the uterus prior to fetal delivery, presents with painful vaginal bleeding; a tender, firm uterus; and fetal heart rate abnormalities. Risk factors include abdominal trauma, maternal hypertension, and tobacco or cocaine use.



both maternal and fetal stability

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Placenta accreta



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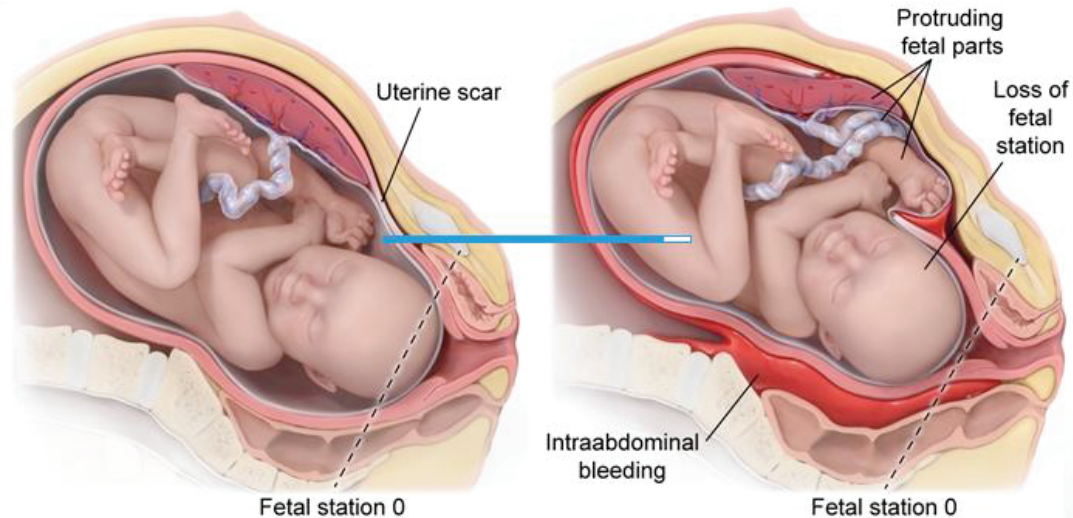
both maternal and fetal stability

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Uterine rupture

Before rupture

After rupture



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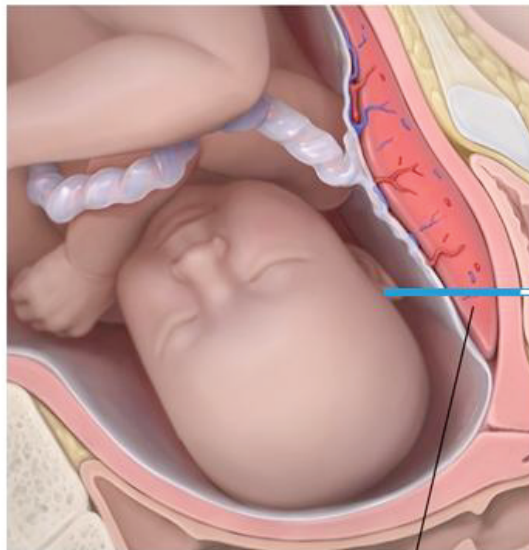
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both maternal and fetal stability

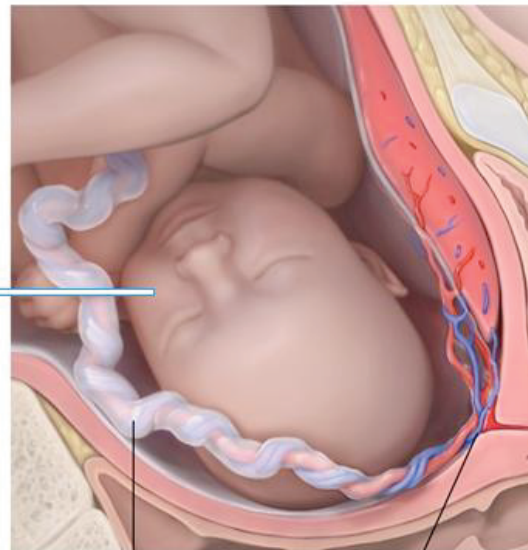
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Normal anatomy



Placenta

Vasa previa



Fetal vessels within
Wharton jelly

Unprotected vessels
at internal os

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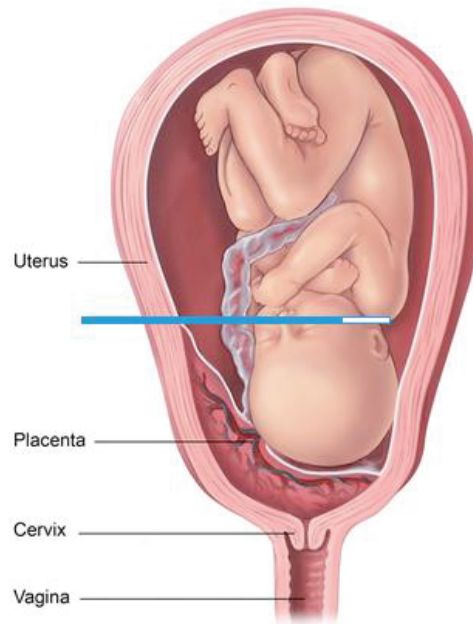
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both maternal and fetal stability

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Placenta previa



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A 41-year-old woman comes to the office for evaluation after a positive home urine pregnancy test. Her last menstrual period was 12 weeks ago. For the past month, the patient has had increasing nausea. She vomits several times a day and has difficulty keeping any food down. The patient has 3 children, all born at term via cesarean section. On this visit, ultrasound demonstrates echogenic intrauterine tissue without an amniotic sac and multiple bilateral ovarian cysts. Dilation and curettage is performed, and hydropic villi are evacuated from the uterus. Which of the following should be closely monitored in this patient after the procedure?

- ☐ A. α -fetoprotein level
- ☒ B. β -hCG level
- ☐ C. Carcinoembryonic antigen level
- ☐ D. CA-125 level
- ☐ E. Vaginal cytology

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Settings

A 41-year-old woman comes to the office for evaluation after a positive home urine pregnancy test. Her last menstrual period was 12 weeks ago. For the past month, the patient has had increasing nausea. She vomits several times a day and has difficulty keeping any food down. The patient has 3 children, all born at term via cesarean section. On this visit, ultrasound demonstrates echogenic intrauterine tissue without an amniotic sac and multiple bilateral ovarian cysts. Dilation and curettage is performed, and hydropic villi are evacuated from the uterus. Which of the following should be closely monitored in this patient after the procedure?

- ☐ A. α -fetoprotein level (3%)
- ☒ B. β -hCG level (84%)
- ☐ C. Carcinoembryonic antigen level (3%)
- ☐ D. CA-125 level (7%)
- ☐ E. Vaginal cytology (0%)



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Hydatidiform mole

Type	Complete	Partial
Clinical features	<ul style="list-style-type: none"> • Vaginal bleeding • Enlarged uterus inconsistent with dates • Extremely high β-hCG levels that can cause: <ul style="list-style-type: none"> ○ Hyperemesis gravidarum ○ Pre-eclampsia ○ Hyperthyroidism ○ Theca-lutein cysts 	<ul style="list-style-type: none"> • Vaginal bleeding • Crampy abdominal pain • Normal uterine size • Normal to high β-HCG levels
Pathologic features	<ul style="list-style-type: none"> • Diffuse trophoblastic proliferation & edematous chorionic villi ("bunch of grapes" appearance) • No fetal/embryonic tissue 	<ul style="list-style-type: none"> • Some enlarged villi with focal trophoblastic proliferation • Fetal/embryonic tissue present
Karyotype	46,XX or XY (paternal DNA only)	69,XXX or XXY (maternal & paternal DNA)



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Immunohistochemistry	p57-negative	p57-positive
Risk of gestational trophoblastic neoplasia	15%-30%	<5%

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Hydatidiform moles are the most common types of gestational trophoblastic disease (GTD). A **complete mole** is composed of multiple cystic **edematous hydropic villi** and has the macroscopic appearance of a **"bunch of grapes"** as a result of trophoblast proliferation. Microscopy would reveal **large villi** (black arrow) with decreased blood vessels, proliferation of the villous trophoblastic lining, and no fetal tissue. Ultrasound confirms the lack of fetal pole and amniotic sac, along with diffuse echogenic material in the uterus (eg, **"snowstorm" pattern**). Immunohistochemistry staining is **p57-negative** in complete moles due to the absence of a maternal genome.

Classic clinical findings of a complete mole include first-trimester **vaginal bleeding** and an enlarged uterine size out of proportion to gestational age. **Hyperemesis gravidarum** can occur from increased β -hCG secretion by the proliferating trophoblast. Excessive β -hCG also stimulates ovarian growth and can cause the formation of **theca-lutein cysts**. Preeclampsia, anemia, and hyperthyroidism can also be present with



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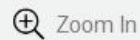
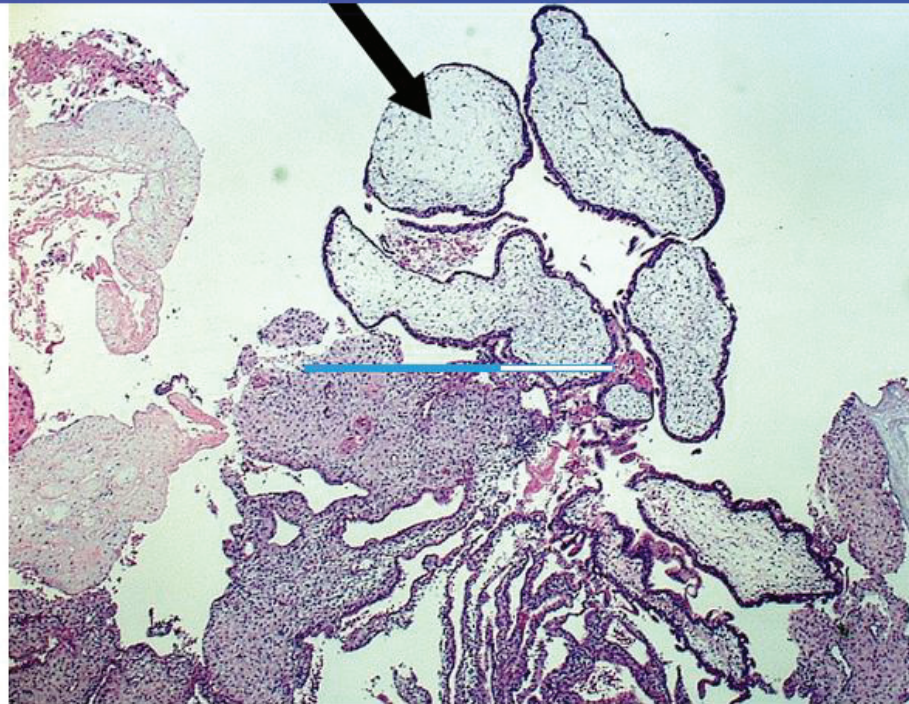


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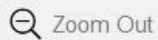


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the formation of **theca-lutein cysts**. Preeclampsia, anemia, and hyperthyroidism can also be present with

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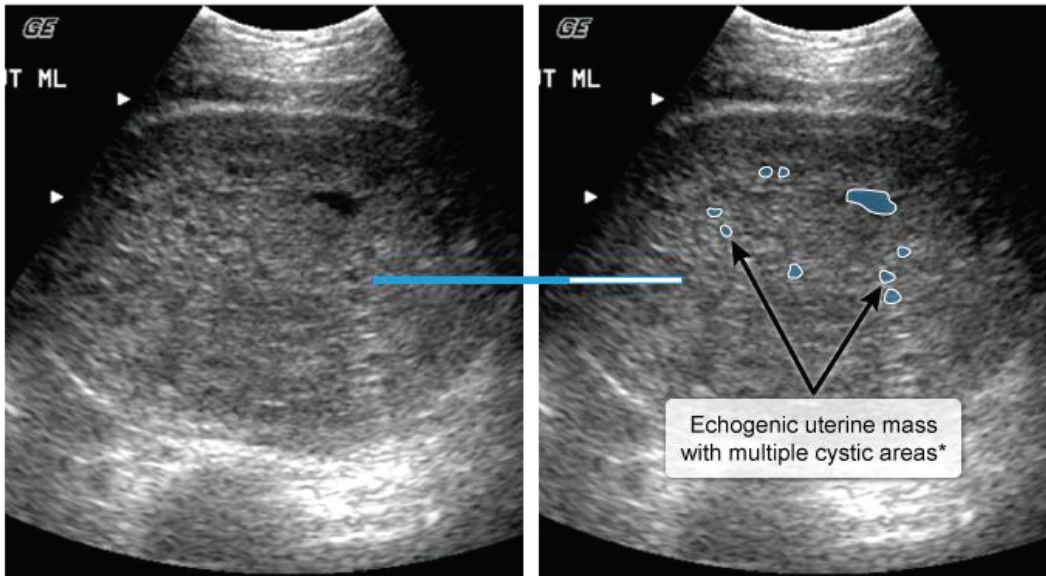
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Complete hydatidiform mole



**"Snowstorm" appearance

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the formation of theca-lutein cysts. Preeclampsia, anemia, and hyperthyroidism can also be present with

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size out of proportion to gestational age. **Hyperemesis gravidarum** can occur from increased β -hCG secretion by the proliferating trophoblast. Excessive β -hCG also stimulates ovarian growth and can cause the formation of **theca-lutein cysts**. Preeclampsia, anemia, and hyperthyroidism can also be present with complete moles.

β -hCG levels must be monitored after uterine evacuation due to significant risk of **malignant transformation**. A level that rises or plateaus is a red flag for neoplastic conversion (eg, invasive mole, choriocarcinoma).

(Choice A) An elevated α -fetoprotein (AFP) level in a pregnant woman may suggest a fetal neural tube defect. Other possible causes of an elevated AFP level include underestimation of gestational age, twin gestation, and abdominal wall defects. AFP is also a marker of yolk sac tumors of the ovaries and testes.

(Choice C) Carcinoembryonic antigen is a marker followed in patients with colorectal carcinoma and is not elevated in GTD.

(Choice D) CA-125 is an ovarian tumor marker and is not used for the evaluation of GTD. This patient's ovarian cysts are likely theca-lutein cysts.

(Choice E) Sarcoma botryoides is a rhabdomyosarcoma that can occur in young girls. It has a jellylike cystic appearance (eg, "bunch of grapes") and arises from the bladder or vaginal mucosa. This patient's





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gestation, and abdominal wall defects. AFP is also a marker of yolk sac tumors of the ovaries and testes.

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(Choice D) CA-125 is an ovarian tumor marker and is not used for the evaluation of GTD. This patient's ovarian cysts are likely theca-lutein cysts.

(Choice E) Sarcoma botryoides is a rhabdomyosarcoma that can occur in young girls. It has a jellylike cystic appearance (eg, "bunch of grapes") and arises from the bladder or vaginal mucosa. This patient's pathology is from the trophoblastic tissue in the uterus.

Educational objective:

A complete mole is composed of multiple cystic edematous hydropic villi as a result of trophoblast proliferation. Serial measurements of β -hCG should be performed following evacuation of a hydatidiform mole. Persistently elevated or rising levels may signify the development of an invasive mole or choriocarcinoma.

References

- Gestational trophoblastic disorders: an update in 2015.
- Practice bulletin no. 53--diagnosis and treatment of gestational trophoblastic disease.



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Settings

A 38-year-old woman, gravida 3 para 2, at 35 weeks gestation comes to the emergency department due to sudden-onset visual changes and headache. The patient reports "spots" in her vision for the past few hours and an occipital headache. She took a dose of acetaminophen, but it did not improve her symptoms. The patient's pregnancy has been complicated by gestational diabetes mellitus requiring insulin. Blood pressure is 168/114 mm Hg and pulse is 90/min. The pupils are equal and reactive to light. Extraocular movements are intact. Visual field testing shows partial loss of vision bilaterally. Which of the following is the most likely cause of this patient's symptoms?

- ☐ A. Choroidal neovascularization
- ☐ B. Decreased anterior chamber angle
- ☐ C. Hemorrhage into the vitreous humor
- ☐ D. Inflammatory optic nerve demyelination
- ☐ E. Retinal artery vasospasm

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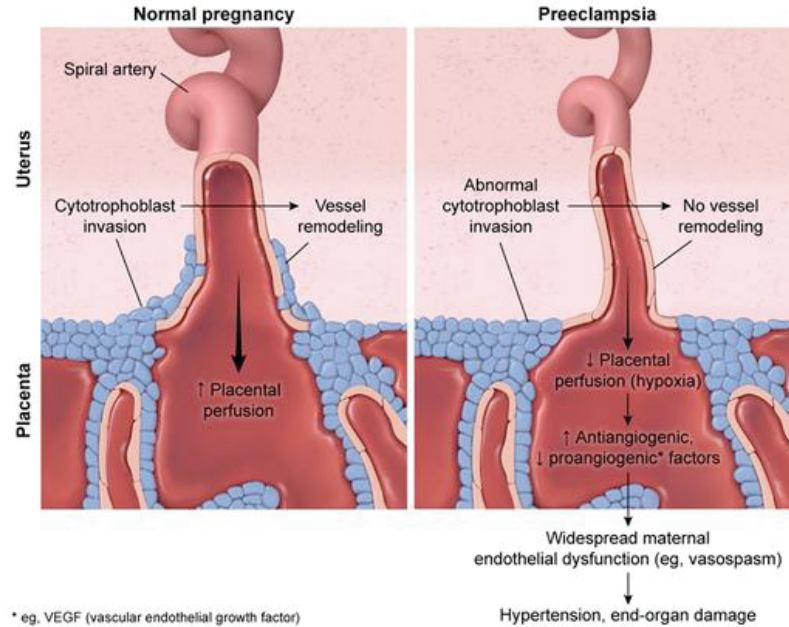
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A 38-year-old woman, gravida 3 para 2, at 35 weeks gestation comes to the emergency department due to sudden-onset visual changes and headache. The patient reports "spots" in her vision for the past few hours and an **occipital headache**. She took a dose of acetaminophen, but it did not improve her symptoms. The patient's pregnancy has been complicated by gestational diabetes mellitus requiring insulin. **Blood pressure** is 168/114 mm Hg and pulse is 90/min. The pupils are equal and reactive to light. Extraocular movements are intact. Visual field testing shows **partial loss** of vision bilaterally. Which of the following is the most likely cause of this patient's symptoms?

- ☐ A. Choroidal neovascularization (18%)
- ☐ B. ~~Decreased anterior chamber angle~~ (8%)
- ☐ C. ~~Hemorrhage into the vitreous humor~~ (26%)
- ☐ D. ~~Inflammatory optic nerve demyelination~~ (5%)
- ☒ E. Retinal artery vasospasm (41%)

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Pathogenesis of preeclampsia



* eg, VEGF (vascular endothelial growth factor)
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This patient has **preeclampsia**, defined as new-onset hypertension (systolic ≥ 140 mm Hg or diastolic ≥ 90 mm Hg) at ≥ 20 weeks gestation with proteinuria and/or signs of end-organ dysfunction. Preeclampsia likely occurs due to abnormal placental development that results in high-resistance, low-perfusion vessels and subsequent placental ischemia. Placental ischemia triggers **widespread endothelial dysfunction**, which causes dysregulated vascular tone (eg, **vasospasm**, vasoconstriction), increased vascular permeability, and decreased end-organ perfusion.

Therefore, a classic presentation of preeclampsia is hypertension with **headache** and **visual changes**:

- Headaches are typically severe and throbbing in nature. They occur due to dysregulated cerebral blood flow, brain ischemia, and/or capillary leakage resulting in cerebral edema.
- Visual changes include blurry vision, photopsia (seeing "sparks"), and **scotomata** (partial vision loss [blind spots]) and are due to **retinal artery vasospasm** and optic nerve ischemia. Eye movement and the pupillary light reflex typically remain intact.

Symptoms usually resolve after delivery, which is curative for preeclampsia. However, in rare cases, patients with severe retinal ischemia or retinal detachment may have permanent vision loss.

(Choice A) Choroidal neovascularization, abnormal vessel growth beneath the retina, causes age-related wet macular degeneration. However, it presents with painless vision loss (no associated headache) and



wet macular degeneration. However, it presents with painless vision loss (no associated headache) and onset of symptoms is typically unilateral (ie, one eye affected first).

(Choice B) A decreased anterior chamber angle (ie, angle-closure glaucoma) can cause headache and visual changes due to increased intraocular pressure. However, patients typically have a painful red eye and a dilated pupil that reacts poorly to light.

(Choice C) Vitreous hemorrhage is associated with eye injury, anticoagulation, and diabetic retinopathy. It typically causes monocular vision loss associated with floaters/photopsia, not bilateral scotomata.

(Choice D) Inflammatory optic nerve demyelination (ie, optic neuritis) causes monocular vision loss and eye pain with extraocular movement. This patient has bilateral visual changes and normal extraocular movement.

Educational objective:

Preeclampsia causes widespread endothelial dysfunction, resulting in dysregulated vascular tone, increased vascular permeability, and decreased end-organ perfusion. Therefore, a common presentation is headache with visual changes (eg, scotomata) due to dysregulated cerebral blood flow and retinal artery vasospasm.

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Settings

A 22-year-old woman at 14 weeks gestation comes to the physician for a prenatal visit. She reports feeling well with the exception of some mild fatigue. Her pregnancy has been uncomplicated to date. On physical examination, the patient's abdomen appears larger than would be expected at 14 weeks. An obstetrical ultrasound reveals twins, a male and a female. Which of the following describes the most likely type of twin placentation in this patient?

- ☐ A. Dichorionic/diamniotic
- ☐ B. Dichorionic/monoamniotic
- ☐ C. Monochorionic/diamniotic
- ☐ D. Monochorionic/monoamniotic
- ☐ E. Monochorionic/monoamniotic conjoined

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A 22-year-old woman at 14 weeks gestation comes to the physician for a prenatal visit. She reports feeling well with the exception of some mild fatigue. Her pregnancy has been uncomplicated to date. On physical examination, the patient's abdomen appears **larger** than would be expected at 14 weeks. An obstetrical ultrasound reveals twins, a male and a female. Which of the following describes the most likely type of twin placentation in this patient?

- ☒ A. Dichorionic/diamniotic (76%)
- ☐ B. Dichorionic/monoamniotic (8%)
- ☐ C. Monochorionic/diamniotic (11%)
- ☐ D. Monochorionic/monoamniotic (2%)
- ☐ E. Monochorionic/monoamniotic conjoined (1%)

Correct

 76%
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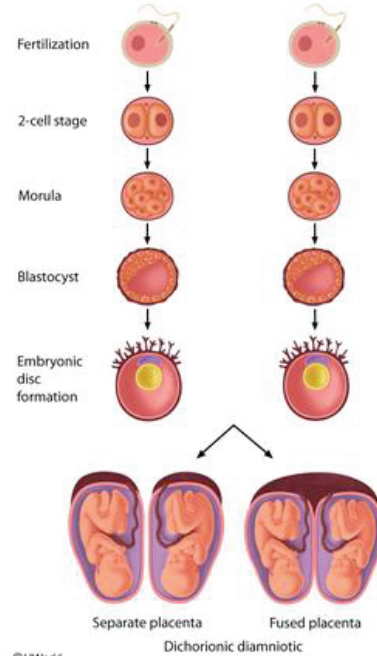
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Dizygotic twinning



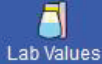
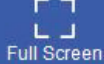
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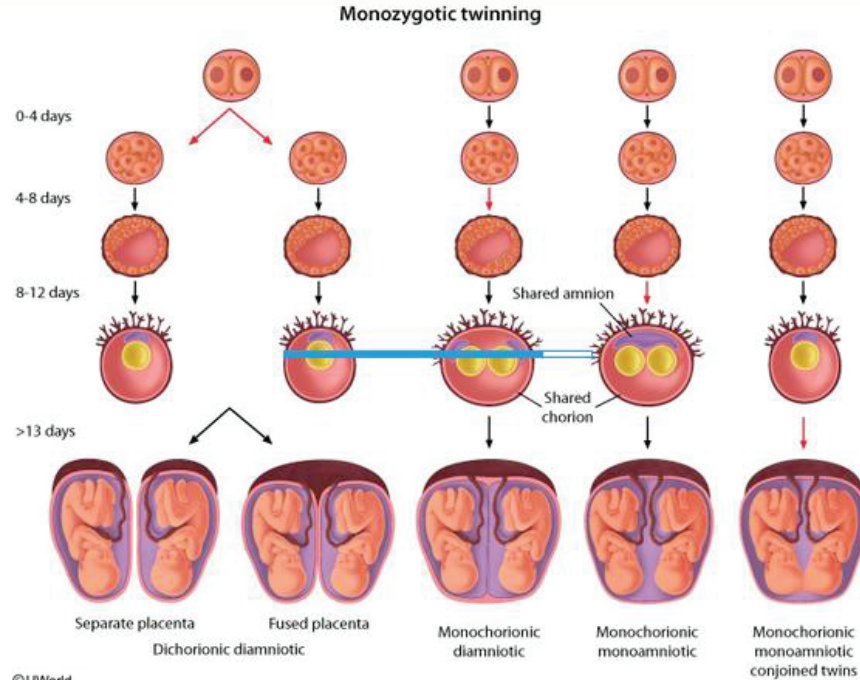
This patient is pregnant with twins of **different sexes** which can only occur in **dizygotic twins** due to the fertilization of 2 oocytes by 2 different sperm. Dizygotic twins are almost always **dichorionic/diamniotic** (eg, 2 chorions and 2 amnions) but may falsely give the appearance of being monochorionic/monoamniotic if the chorions and amnions fuse due to proximity of implantation sites.

In contrast, **monozygotic twins** develop from division of a single zygote after fertilization of a single oocyte. They are of the **same sex**, are genetically identical, and are similar in appearance. The type of placentation in monozygotic twins depends on when zygote division occurs during embryonic development.

- Early division (days 0-4) can result in monozygotic twins with 2 chorions and 2 amnions (eg, dichorionic/diamniotic), which may or may not be fused. If the sexes are the same, it may be difficult to distinguish whether the twins are monozygotic or dizygotic until later in the pregnancy.
- Division between days 4-8 is the most common outcome in monozygotic twins and results in 1 chorion (eg, shared placenta) but 2 amnions (eg, monochorionic/diamniotic twins) **(Choice C)**.
- Late division (8-12 days) results in 1 chorion and 1 amnion. A monochorionic/monoamniotic pregnancy is associated with a high fetal fatality rate, due primarily to the increased risk of umbilical cord entanglement **(Choice D)**.
- Division occurring after 13 days can result in monochorionic/monoamniotic conjoined twins **(Choice**



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A 37-year-old woman, gravida 3 para 1, at 28 weeks gestation comes to the office due to loss of urine with cough. She reports fetal movement and has had an uneventful pregnancy. Several years ago she had a spontaneous vaginal delivery of a 3.5-kg infant. The patient has had no medical problems or surgeries. Her prepregnancy BMI is 32 kg/m². She has gained approximately 15.88 kg (35 lb) during this pregnancy. Urine culture is negative. Which of the following is the most likely mechanism for this patient's urinary incontinence?

- ☐ A. Decreased systemic blood volume
- ☐ B. Detrusor muscle hyperactivity
- ☐ C. Increased intraabdominal pressure
- ☐ D. Sciatic nerve root compression
- ☐ E. Ureteral compression
- ☐ F. Urinary tract infection

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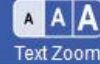
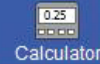
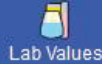
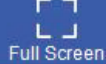
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A 37-year-old woman, gravida 3 para 1, at 28 weeks gestation comes to the office due to **loss** of **urine** with cough. She reports fetal movement and has had an uneventful pregnancy. Several years ago she had a spontaneous vaginal delivery of a 3.5-kg infant. The patient has had no medical problems or surgeries. Her prepregnancy BMI is 32 kg/m². She has gained approximately 15.88 kg (35 lb) during this pregnancy. Urine culture is negative. Which of the following is the most likely mechanism for this patient's urinary incontinence?

- ☐ A. ~~Decreased systemic blood volume (0%)~~
- ☐ B. ~~Detrusor muscle hyperactivity (4%)~~
- ☒ C. Increased intraabdominal pressure (86%)
- ☐ D. ~~Sciatic nerve root compression (1%)~~
- ☐ E. ~~Ureteral compression (6%)~~
- ☐ F. ~~Urinary tract infection (0%)~~





Differential diagnosis of urinary incontinence

	Etiology	Symptoms
Stress	↓ Urethral sphincter tone Urethral hypermobility	Leakage with coughing, lifting, sneezing
Urge	Detrusor hyperactivity	Sudden, overwhelming urge to urinate
Overflow	Impaired detrusor contractility Bladder outlet obstruction	Incomplete emptying & persistent involuntary dribbling

Stress urinary incontinence is a common and bothersome symptom during pregnancy. Physiologic changes in pregnancy include an increase in plasma volume (**Choice A**) to accommodate potential blood loss during parturition. A rise in glomerular filtration rate occurs with increased renal circulation mediated by the hormone relaxin, which is in turn stimulated by β -hCG. These changes result in a greater volume of urine and lead to increased urinary frequency due to unchanged and eventually diminished bladder capacity from direct compression of the bladder by the fetus. The gravid uterus and maternal weight gain increase intraabdominal pressure. In addition, pregnancy hormones decrease urethral tone and relax





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increase intraabdominal pressure. In addition, pregnancy hormones decrease urethral tone and relax the pelvic floor muscles (**levator ani, coccygeus**), which function with the urethral valve to maintain continence. Laughing, coughing, and other exertions cause sudden additional increases in intraabdominal pressure and exceed the pressure point that maintains closure of the urethral valve. Forced opening of the valve results in urine leakage. **Kegel exercises** strengthen the pelvic floor muscles and can improve symptoms of stress urinary incontinence.

(Choice B) Urge incontinence is characterized by involuntary detrusor muscle contractions ("overactive bladder") before the bladder is full. Patients typically have frequent loss of large amounts of urine or urgency with small voiding amounts. These symptoms are not associated with exertional activities or cough.

(Choice D) The sciatic nerve can become compressed due to increased joint laxity from circulating relaxin and changes in maternal posture (eg, spinal lordosis). Sciatica commonly presents as low back pain radiating down one side of the hip to the leg, without urinary incontinence.

(Choices E and F) The gravid uterus causes ureteral compression that may result in physiologic hydronephrosis (eg, dilation of the ureter). Although ureteral dilation does not cause incontinence, the resulting urinary stasis becomes a breeding ground for bacteria and predisposes pregnant women to



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(Choice D) The sciatic nerve can become compressed due to increased joint laxity from circulating relaxin and changes in maternal posture (eg, spinal lordosis). Sciatica commonly presents as low back pain radiating down one side of the hip to the leg, without urinary incontinence.

(Choices E and F) The gravid uterus causes ureteral compression that may result in physiologic hydronephrosis (eg, dilation of the ureter). Although ureteral dilation does not cause incontinence, the resulting urinary stasis becomes a breeding ground for bacteria and predisposes pregnant women to urinary tract infections. Negative urine culture denotes a lack of bacteriuria and effectively rules out infection.

Educational objective:

A common symptom during pregnancy is stress urinary incontinence, which occurs due to increased intraabdominal pressure from the gravid uterus that exceeds the pressure point that maintains closure of the urethral valve. Pregnancy hormones decrease urethral tone and relax the pelvic floor muscles (levator ani, coccygeus), which maintain closure of the urethral valve.

References

- Stress urinary incontinence in pregnant women: a review of prevalence, pathophysiology, and treatment.



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A newborn boy is being evaluated in the nursery. The patient was born at 39 weeks gestation via cesarean delivery to a 30-year-old primigravida. Head circumference, weight, and length are at the 75th to 90th percentiles. The anterior fontanelle is open and soft. The neck is supple. Cardiopulmonary examination is unremarkable, and the abdomen is soft. The back appears unremarkable. Hip examination shows no hip clicks. Both feet are plantar flexed and adducted with the soles pointing medially. There is resistance to range of motion assessment in both feet. Muscle tone is normal and newborn reflexes are intact. The abnormal findings on this patient's physical examination most likely represent which of the following types of congenital anomalies?

- ☐ A. Deformation
- ☐ B. Disruption
- ☐ C. Dysplasia
- ☐ D. Malformation
- ☐ E. Sequence



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delivery to a 30-year-old primigravida. Head circumference, weight, and length are at the 75th to 90th percentiles. The anterior fontanelle is open and soft. The neck is **supple**. Cardiopulmonary examination is unremarkable, and the abdomen is soft. The back appears unremarkable. Hip examination shows no hip clicks. Both feet are plantar flexed and adducted with the soles pointing medially. There is resistance to range of motion assessment in both feet. Muscle tone is normal and newborn reflexes are intact. The abnormal findings on this patient's physical examination most likely represent which of the following types of congenital anomalies?

- ☒ A. Deformation (46%)
- ☐ B. Disruption (12%)
- ☐ C. Dysplasia (8%)
- ☐ D. Malformation (21%)
- ☒ E. Sequence (11%)

Incorrect

Correct answer



46%



58 secs



02/15/2021

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This newborn has **talipes equinovarus** (ie, clubfoot), a congenital anomaly in which one or both feet are **rigidly flexed downward and inward**.

Talipes equinovarus is a **deformation anomaly**, or a structural abnormality caused by **extrinsic forces** on the **developing fetus**. Normal growth and positioning of the foot are restricted due to poor in utero mobility (eg, multiple gestation, breech positioning). Subsequent **underdevelopment** of the **talus bone** causes subluxation of the surrounding joints and shortening of the adjacent calf muscles and tendons. The result is hyperplantar flexion with adduction and medial deviation of the foot. Soft tissue contractures and bony misalignment lead to a rigid deformity that resists range-of-motion testing.

Clubfoot is a clinical diagnosis, and treatment involves manipulation and stretching with serial casting.

(Choice B) Disruption refers to destruction of a structure that was previously developing normally. For example, **amniotic bands** are fibrous tissues that encircle and constrict fetal limbs, disrupting previously normal development. Constriction rings, hypoplasia, or amputation of the distal extremity is seen on examination.

(Choice C) Dysplasia is the proliferation of abnormal cells, which can lead to the abnormal formation of an



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examination.

(Choice C) Dysplasia is the proliferation of abnormal cells, which can lead to the abnormal formation of an organ, such as the acetabulum in patients with developmental dysplasia of the hip (DDH). Restrictive, extrinsic forces can also contribute to DDH, but examination would reveal a **hip clunk on examination** due to femoral head dislocation.

(Choice D) A congenital malformation is due to an intrinsic defect (eg, genetic, teratogenic) that prevents the proper development of a structure. For example, **spina bifida**, a malformation of the spine and spinal cord, is caused by failure of neural tube closure. Although clubfoot can be associated with spina bifida, an outpouching (eg, meningocele, myelomeningocele) or hair tuft (eg, spina bifida occulta) would be expected on the lower back.

(Choice E) A sequence refers to a group of anomalies seen together that represent a cascade effect from a single defect. For instance, Potter sequence is characterized by flat facies, pulmonary hypoplasia, and limb deformities (eg, clubfoot) that result from oligohydramnios due to a urinary tract anomaly. This patient has isolated feet deformities with an otherwise normal examination.

Educational objective:

A deformation anomaly is caused by extrinsic forces on a developing fetus. Talipes equinovarus (ie,



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to femoral head dislocation.

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Educational objective:

A deformation anomaly is caused by extrinsic forces on a developing fetus. Talipes equinovarus (ie, clubfoot), in which the foot is rigidly flexed downward and inward, is a deformation anomaly involving an underdeveloped talus bone.

Embryology

Pregnancy, Childbirth & Puerperium

Clubfoot





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Settings

An infant born to a 26-year-old woman is evaluated shortly after delivery. Birth weight and length are at the 10th and 15th percentiles, respectively. Vital signs are normal. Physical examination shows a protruding tongue, excessive skin at the nape of the neck, and upslanting palpebral fissures. The startle reflex is symmetric and weak. Cardiac auscultation reveals a harsh, III/VI systolic murmur heard best over the lower left sternal border. The patient has normal external female genitalia. Review of maternal medical records shows a past history of 2 spontaneous abortions in the last 3 years. Echocardiography confirms the presence of a ventricular septal defect. Which of the following karyotypes is most likely to be found in this infant?

- ☐ A. 45,XO
- ☐ B. 46,XX, del(22)(q11)
- ☐ C. 46,XX, t(9;22)
- ☐ D. 46,XX, t(14;21)
- ☐ E. 47,XX, +18



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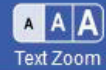
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Settings

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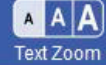
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- ☐ A. 45,XO (29%)
- ☐ B. 46,XX, del(22)(q11) (7%)
- ☐ C. 46,XX, t(9;22) (1%)
- ☒ D. 46,XX, t(14;21) (45%)
- ☐ E. 47,XX, +18 (15%)

Correct



45%

Answered correctly



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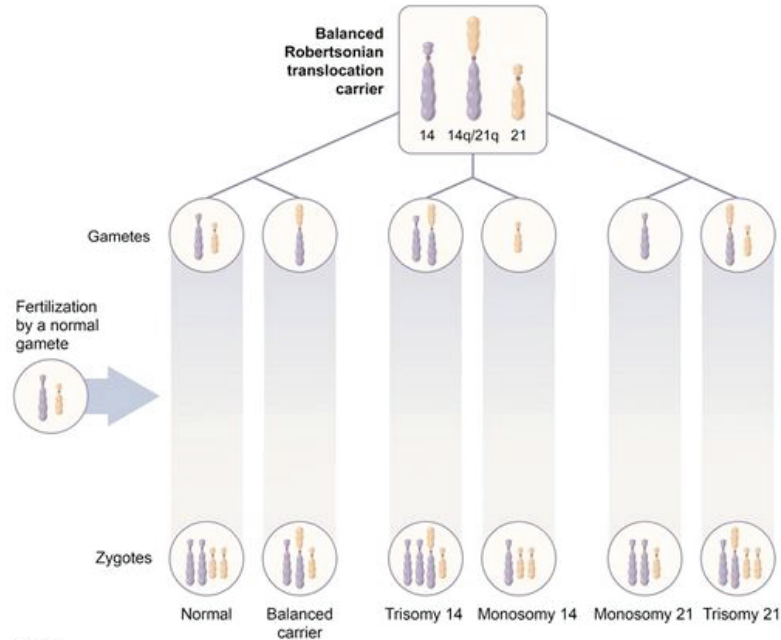
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Exhibit Display

Robertsonian translocation



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Down syndrome is most commonly caused by random **meiotic nondisjunction**, an abnormality that correlates with increasing maternal age and results in **3 complete copies** of chromosome 21 (47, XX, +21).

Translocation Down syndrome, which is less common, can be inherited from an unaffected parent with a **balanced translocation**. Robertsonian translocations occur between 2 acrocentric, nonhomologous chromosomes (eg, 14 and 21). The resultant translocated chromosomes are the **fusion of 2 long arms** (eg, 14q and 21q [red arrow]) and the fusion of 2 short arms (eg, 14p and 21p); the latter usually contains nonessential genetic material and is lost after several cell divisions. The affected parent is asymptomatic because they have a normal (albeit rearranged) genetic complement. However, when an ovum containing the translocated chromosome and a normal chromosome 21 is fertilized with a sperm containing a normal set of chromosomes (ie, 1 copy of chromosome 21), the resultant fetus has an **unbalanced Robertsonian translocation** with **46 chromosomes** and **3 effective copies** of chromosome 21 [**46,XX, t(14;21)**]. Another possible maternal gamete includes 0 copies of chromosome 21, which increases the rate of **miscarriages** in balanced Robertsonian translocation carriers.

Dysmorphic features of Down syndrome include epicanthal folds, upslanting palpebral fissures, a protruding tongue, and excessive skin at the nape of the neck. Birth weight and length are often below average, and hypotonia and a weak startle (Moro) reflex are characteristic. Cardiac defects are present in



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>50% of cases.

(Choice A) Turner syndrome (45,XO) presents with low-set ears, a webbed neck, wide-spaced nipples, and cardiac defects (eg, aortic coarctation). Most cases are due to absence of the paternally contributed X chromosome.

(Choice B) DiGeorge syndrome, caused by sporadic 22q11 deletions, presents with hypertelorism, micrognathia, cleft palate, and cardiac defects (eg, interrupted aortic arch, Tetralogy of Fallot).

(Choice C) The Philadelphia chromosome is a balanced translocation between chromosomes 9 and 22 that produces an oncogenic fusion gene (*BCR-ABL*) associated with chronic myelogenous leukemia.

(Choice E) Trisomy 18 (47, XX, +18), or Edwards syndrome, usually arises secondary to meiotic nondisjunction with maternal age ≥ 35 . Findings include dysmorphic facies (eg, micrognathia, low-set ears), clenched hands with overlapping fingers, and hypertonia.

Educational objective:

Unbalanced Robertsonian translocations account for a minority of Down syndrome cases. Karyotyping shows 46 chromosomes with a translocation between 2 acrocentric nonhomologous chromosomes [eg, 46, XX, t(14;21)].



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Settings

A 26-year-old woman comes to the emergency department for pelvic pain and vaginal bleeding over the past 2 days. Today, the pain has increased, but she has had no nausea, vomiting, or orthostasis. The patient was treated for chlamydia cervicitis 3 years ago. She takes no medications and has no known drug allergies. On pelvic examination, the uterus is small and mobile and there is left adnexal tenderness. Pelvic ultrasound reveals a complex, 2-cm left adnexal mass with a gestational sac and yolk sac; there is no intrauterine pregnancy or free fluid. The patient is counseled on recommended medical treatment. Which of the following is the mechanism of action of the agent of choice for this patient?

- ☐ A. Blocks progesterone receptors, resulting in uterine contractions
- ☐ B. Decreases LH secretion, causing endometrial thinning
- ☐ C. Induces prostaglandin-mediated uterine contractions
- ☐ D. Inhibits DNA synthesis to destroy actively proliferating fetal cells
- ☐ E. Produces local inflammation to impair implantation

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Settings

A 28-year-old woman, gravida 3 para 3, comes to the emergency department with severe abdominal pain in the left lower quadrant and vaginal bleeding. She is saturating a pad every 3-4 hours. Her last menstrual period was 6 weeks ago. Past surgical history is significant for 3 cesarean deliveries and permanent sterilization via a bilateral tubal ligation. A urine pregnancy test is positive, and an ultrasound shows a 2-cm mass in the left adnexa adjacent to the ovary and a thickened endometrial stripe. If a uterine curettage is performed, which of the following findings would be expected in this patient?

- ☐ A. Atypical endometrial cells, disorganized glands, and multiple mitoses (10%)
- ☒ B. Dilated, coiled endometrial glands and edematous stroma (56%)
- ☐ C. Enlarged chorionic villi and avascular edematous stroma (25%)
- ☐ D. Inflammatory infiltration of endometrial glands (3%)
- ☐ E. Straight, short endometrial glands and compact stroma (3%)

Correct

 56%
Answered correctly 01 min, 14 secs
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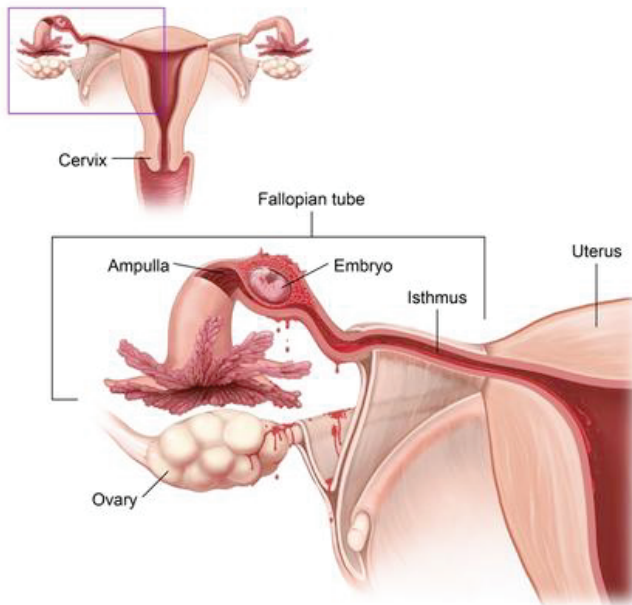
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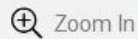
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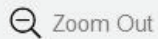
Ectopic pregnancy with ruptured fallopian tube



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Ectopic pregnancy occurs when a **fertilized ovum implants outside of the uterus**. The most common site is the **ampulla** of the fallopian tube, which may appear as an adnexal mass on ultrasound. Risk factors include tubal pathology, such as from previous infection or surgery (eg, **tubal ligation**). Pregnancy after permanent sterilization is extremely rare, but one-third of cases are ectopic if implantation occurs. An ectopic pregnancy may become life-threatening as the embryo and trophoblastic tissue proliferate. This growth will compromise the blood supply to the surrounding tissues, which can result in rupture and profuse intra-abdominal bleeding.

A ruptured ectopic pregnancy is managed surgically by removing the pregnancy and achieving hemostasis. Dilation and curettage of the uterus may be performed either to stop uterine bleeding or confirm whether the pregnancy is intrauterine or ectopic. In an ectopic pregnancy, the uterine specimen would reveal **decidualized endometrium** only, consistent with **dilated, coiled endometrial glands** and **vascularized edematous stroma**. These changes occur in the luteal phase of the **menstrual cycle**, under the influence of **progesterone**, as the endometrium prepares for implantation. Embryonic and trophoblastic tissue will be absent from the uterus.

(Choice A) The finding of atypical endometrial cells that form glands would suggest **endometrial**



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(Choice A) The finding of atypical endometrial cells that form glands would suggest **endometrial adenocarcinoma**, a malignancy that typically occurs in postmenopausal women and manifests with vaginal bleeding.

(Choice C) A molar pregnancy or spontaneous abortion may present with vaginal bleeding. Uterine curettage may show enlarged chorionic villi and avascular edematous stroma. In contrast, intrauterine chorionic villi are absent in an ectopic pregnancy.

(Choice D) An inflammatory endometrial infiltrate would suggest endometritis, an infection of the decidua, which presents with uterine tenderness, fever, and tachycardia. An ectopic pregnancy is not an infectious process.

(Choice E) Straight, short endometrial glands and compact stroma are found in the early **proliferative phase of the menstrual cycle**. This microscopic appearance would be observed 4-7 days after the onset of menses.

Educational objective:

An ectopic pregnancy is characterized by implantation outside of the uterus. Uterine curettage would reveal decidual changes in the endometrium due to progesterone secretion but no embryonic or trophoblastic tissue (eg, no villi).



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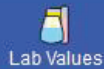
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A 26-year-old woman comes to the emergency department for pelvic pain and vaginal bleeding over the past 2 days. Today, the pain has increased, but she has had no nausea, vomiting, or orthostasis. The patient was treated for chlamydia cervicitis 3 years ago. She takes no medications and has no known drug allergies. On pelvic examination, the uterus is small and mobile and there is left adnexal tenderness. Pelvic ultrasound reveals a complex, 2-cm left adnexal mass with a gestational sac and yolk sac; there is no intrauterine pregnancy or free fluid. The patient is counseled on recommended medical treatment. Which of the following is the mechanism of action of the agent of choice for this patient?

- ☐ A. Blocks progesterone receptors, resulting in uterine contractions (7%)
- ☐ B. Decreases LH secretion, causing endometrial thinning (3%)
- ☐ C. Induces prostaglandin-mediated uterine contractions (13%)
- ☒ D. Inhibits DNA synthesis to destroy actively proliferating fetal cells (73%)
- ☐ E. Produces local inflammation to impair implantation (1%)



Medications used for pregnancy termination

Methotrexate

- Ectopic pregnancy
- Folic acid antagonist (inhibits dihydrofolate reductase)
- Preferentially destroys proliferating fetal cells

Mifepristone

- Abortion
- Partial progesterone agonist (acts as progesterone antagonist during pregnancy)
- Promotes placental separation & uterine contractions

Misoprostol

- Abortion
- Prostaglandin E1 agonist
- Stimulates uterine contractions

This patient with pelvic pain, vaginal bleeding, and a tender left adnexal mass containing a gestational sac and yolk sac has an **ectopic pregnancy**. Ectopic pregnancies occur due to pregnancy implantation in an extrauterine location, most commonly the **fallopian tube**. Risk factors include prior sexually transmitted infection (eg, *Chlamydia trachomatis*), prior abdominal surgery, and prior ectopic pregnancy.



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infection (eg, *Chlamydia trachomatis*), prior abdominal surgery, and prior ectopic pregnancy.

Medical treatment for an early, unruptured ectopic pregnancy is with **methotrexate**, a **folic acid antagonist**. Methotrexate works by directly competing with folic acid to bind dihydrofolate reductase, thereby inhibiting the formation of tetrahydrofolate. This decrease in tetrahydrofolate, an integral precursor to purine and pyrimidine synthesis, **inhibits DNA synthesis** and cell reproduction. The result is **preferential destruction of actively proliferating cells**, such as **fetal cells and trophoblasts**.

(Choice A) During pregnancy, the uterus increases its number of progesterone receptors so that circulating progesterone can stimulate the endometrial and myometrial growth required for pregnancy implantation and development. Mifepristone, which acts as a progesterone antagonist when progesterone levels are high, is used for medical abortion because it causes necrosis of the uterine decidua and stimulates uterine contractions.

(Choice B) Progestins (eg, levonorgestrel) thin the endometrial lining and decrease LH secretion, thereby inhibiting ovulation and preventing pregnancy. They are not used in ectopic pregnancy management.

(Choice C) Misoprostol is a synthetic prostaglandin E1 agonist that acts on the uterus to induce contractions; it can be used for labor induction or medical abortion.

(Choice E) Copper-containing intrauterine devices produce local inflammation to impair intrauterine



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stimulates uterine contractions.

(Choice B) Progestins (eg, levonorgestrel) thin the endometrial lining and decrease LH secretion, thereby inhibiting ovulation and preventing pregnancy. They are not used in ectopic pregnancy management.

(Choice C) Misoprostol is a synthetic prostaglandin E1 agonist that acts on the uterus to induce contractions; it can be used for labor induction or medical abortion.

(Choice E) [Copper-containing intrauterine devices](#) produce local inflammation to impair intrauterine implantation. They are not used to treat ectopic pregnancies, which have implanted outside the uterus.

Educational objective:

Ectopic pregnancy occurs due to pregnancy implantation in an extrauterine location (eg, fallopian tube). Medical treatment is with methotrexate, which inhibits DNA synthesis and cell reproduction, primarily in actively proliferating cells such as fetal cells and trophoblasts.

References

- [Medical management of ectopic pregnancy: a comparison of regimens.](#)

Pharmacology

Pregnancy, Childbirth & Puerperium

Ectopic pregnancy

Subject

System

Topic





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A 38-year-old woman, gravida 1 para 0, at 34 weeks gestation comes to the office due to increasing swelling in her hands and legs. The patient first noticed the swelling a few weeks ago but now cannot stand for more than an hour without needing to elevate her legs. She has no orthopnea, dyspnea, or chest pain. The patient has no chronic medical conditions and takes no daily medications. Vital signs are normal. Cardiac examination is within normal limits. Lungs are clear to auscultation. Bilateral lower extremities have 2+ pitting edema to the midshin. Urine dipstick shows no protein. Compared to a healthy nonpregnant woman, which of the following parameters is most likely to be decreased in this patient?

- ☐ A. Cardiac preload (11%)
- ☐ B. Cardiac output (3%)
- ☐ C. Central venous pressure (9%)
- ☐ D. Plasma volume (5%)
- ☒ E. Systemic vascular resistance (69%)



Maternal cardiopulmonary adaptations to pregnancy

Maternal adaptations	<ul style="list-style-type: none">• Cardiac<ul style="list-style-type: none">◦ ↑ Cardiac output◦ ↑ Plasma volume◦ ↓ Systemic vascular resistance• Respiratory<ul style="list-style-type: none">◦ ↑ Tidal volume◦ ↓ Functional residual capacity (elevation of diaphragm)
Clinical manifestations	<ul style="list-style-type: none">• Peripheral edema• ↓ Blood pressure• ↑ Heart rate• Systolic ejection murmur• Dyspnea

During pregnancy, the maternal cardiovascular system undergoes physiologic adaptations to increase



During **pregnancy**, the maternal cardiovascular system undergoes **physiologic adaptations** to increase cardiac output and optimize fetal perfusion. The most significant hemodynamic change is a **marked decrease in systemic vascular resistance (SVR)**, which occurs due to increased release of peripheral vasodilators (eg, nitric oxide, prostacyclin) and decreased vascular sensitivity to vasoconstrictors (eg, norepinephrine, angiotensin II). The formation of a high-flow, low-resistance circuit within the uterus and placenta also contributes to decreased SVR.

Decreased SVR induces mild hypotension, which along with direct stimulation by placental hormones, leads to activation of the renin-angiotensin-aldosterone system. This results in fluid retention and an **increase in plasma blood volume** of up to 40% in pregnancy (**Choice D**). This physiologic increase in plasma blood volume inevitably results in increased venous return (ie, increased cardiac preload), which together with reduced SVR (ie, decreased cardiac afterload) facilitates a **greater stroke volume** and **increased cardiac output (Choices A and B)**.

Pulmonary vascular resistance (PVR) also decreases during pregnancy, likely via the same vasodilatory mechanisms as SVR. This helps accommodate the increased preload to the right heart while maintaining a **normal central venous pressure (CVP) (Choice C)**. Vascular capacitance (ie, the ability of systemic veins to stretch) also helps accommodate increased total blood volume without affecting the CVP.



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mechanisms as SVR. This helps accommodate the increased preload to the right heart while maintaining a **normal central venous pressure (CVP) (Choice C)**. Vascular capacitance (ie, the ability of systemic veins to stretch) also helps accommodate increased total blood volume without affecting the CVP.

Despite normal CVP, **peripheral edema** is common in pregnancy due to the increase in plasma volume resulting in **decreased blood oncotic pressure**; this change encourages leakage of intravascular fluid into dependent peripheral tissue (eg, lower extremities).

Educational objective:

During pregnancy, systemic vascular resistance decreases and plasma blood volume increases. Venous capacitance and a decrease in pulmonary vascular resistance allow for accommodation of increased blood volume without affecting central venous pressure (CVP). Despite a normal CVP, peripheral edema is common in pregnancy due to decreased capillary oncotic pressure that encourages leakage of fluid into dependent peripheral tissues (eg, lower extremities).

Physiology

Pregnancy, Childbirth & Puerperium

Cardiac physiology

Subject

System

Topic

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Item 2 of 9

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Settings

A 28-year-old woman, gravida 3 para 2, at 31 weeks gestation comes to the office for a prenatal visit. The patient has had increasing shortness of breath while climbing stairs and during long walks for the past few weeks but has had no cough, sick contacts, hemoptysis, orthopnea, or chest pain. She has had no contractions or vaginal bleeding, and fetal movement is normal. The patient has no chronic medical conditions, and her pregnancy has been uncomplicated. Blood pressure is 110/80 mm Hg, pulse is 70/min, and respirations are 18/min. Fetal heart tones are normal. Cardiac examination reveals no rubs or murmurs. The lungs are clear to auscultation bilaterally. The remainder of the examination is unremarkable. Which of the following laboratory findings will most likely be found in this patient?

	pH	PaCO ₂ (mm Hg)	PaO ₂ (mm Hg)	Urine bicarbonate
<input type="radio"/> A.	7.26	45	101	↓
<input type="radio"/> B.	7.34	30	97	↑
<input type="radio"/> C.	7.46	29	102	↑
<input type="radio"/> D.	7.48	44	98	↓

Block Time Remaining: 00:01:02

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Feedback

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<input type="radio"/> D.	7.48	44	98	↓
<input type="radio"/> E.	7.60	25	94	↓





contractions or vaginal bleeding, and fetal movement is normal. The patient has no chronic medical conditions, and her pregnancy has been uncomplicated. Blood pressure is 110/80 mm Hg, pulse is 70/min, and respirations are 18/min. Fetal heart tones are normal. Cardiac examination reveals no rubs or murmurs. The lungs are clear to auscultation bilaterally. The remainder of the examination is unremarkable. Which of the following laboratory findings will most likely be found in this patient?

	pH	PaCO ₂ (mm Hg)	PaO ₂ (mm Hg)	Urine bicarbonate	
<input type="radio"/> A.	7.26	45	101	↓	(14%)
<input checked="" type="radio"/> B.	7.34	30	97	↑	(21%)
<input checked="" type="radio"/> C.	7.46	29	102	↑	(38%)
<input type="radio"/> D.	7.48	44	98	↓	(16%)
<input type="radio"/> E.	7.60	25	94	↓	(8%)

Incorrect

Correct answer

38%

01 min, 50 secs

12/24/2020

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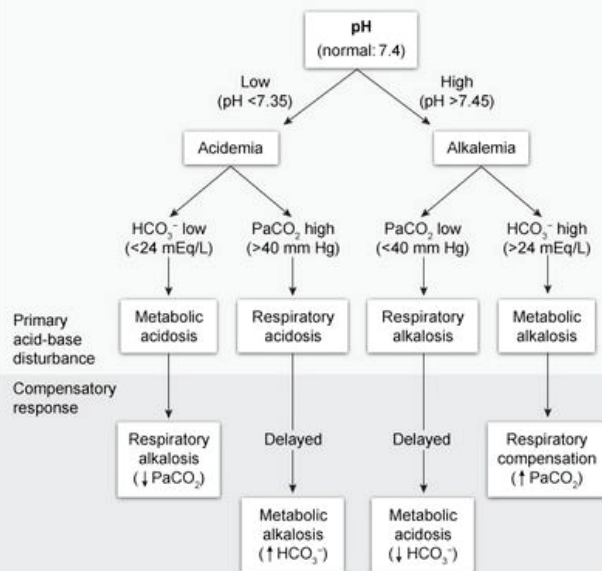


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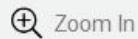
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Arterial blood gas interpretation of acid-base disorders

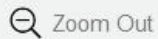


* The normal ranges for PaCO₂ and HCO₃⁻ vary slightly around 40 mm Hg and 24 mEq/L. For simplicity, these numbers should be used as a normal baseline for acid-base calculations.
HCO₃⁻ = bicarbonate; PaCO₂ = partial pressure of carbon dioxide in arterial blood.

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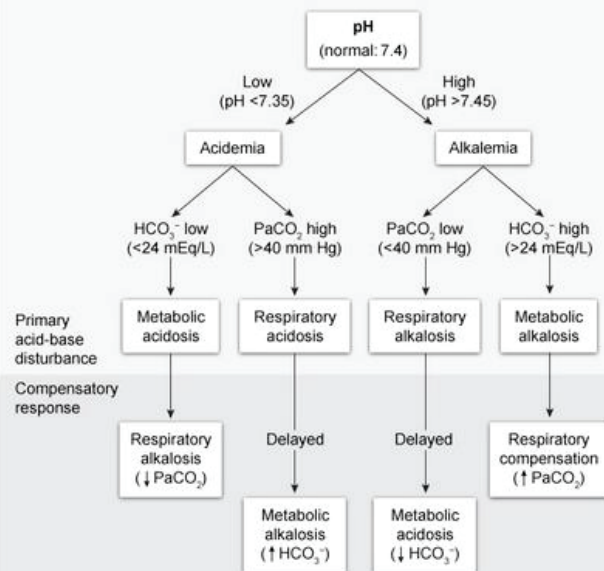
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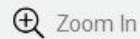
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Arterial blood gas interpretation of acid-base disorders

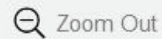


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HCO₃⁻ = bicarbonate; PaCO₂ = partial pressure of carbon dioxide in arterial blood.

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The **normal physiology of pregnancy** involves **chronic hyperventilation**. Elevated **progesterone** levels trigger a sensation of **shortness of breath** and stimulate the hypothalamus to increase respiratory drive. Ventilation is increased primarily via **increased tidal volume**, which is facilitated by increased diaphragmatic excursion and hormone-induced laxity of the intercostal muscles that allows for enlargement of the thoracic cavity (although the expanding uterus displaces the resting position of the diaphragm upward, diaphragmatic excursion is not impaired). A slight increase in respiratory rate also contributes.

The hyperventilation of pregnancy creates an expected **respiratory alkalosis** (ie, pH >7.45 and partial pressure of carbon dioxide in arterial blood [PaCO_2] <40 mm Hg) with metabolic compensation (**increased renal bicarbonate** [HCO_3^-] **excretion**). Arterial oxygenation is also increased slightly above normal (ie, arterial partial pressure of oxygen [PaO_2] >100 mm Hg). These changes help facilitate the transport of acidic wastes from, and the transport of oxygen to, the developing fetus.

(Choice A) Low pH (<7.35) with elevated PaCO_2 (>40 mm Hg) indicates respiratory acidosis. Urine HCO_3^- is low as the kidneys increase HCO_3^- reabsorption for metabolic compensation.

(Choice B) Low pH is not explained by low PaCO_2 (<40 mm Hg); therefore, the low PaCO_2 likely represents respiratory compensation for metabolic acidosis. Renal loss of HCO_3^- (ie, high urine HCO_3^-), as





(Choice B) Low pH is not explained by low PaCO_2 (<40 mm Hg); therefore, the low PaCO_2 likely represents respiratory compensation for metabolic acidosis. Renal loss of HCO_3^- (ie, high urine HCO_3^-), as occurs with renal tubular acidosis, is a common cause of metabolic acidosis.

(Choice D) High pH (>7.45) is not explained by elevated PaCO_2 ; therefore, the elevated PaCO_2 likely represents respiratory compensation for metabolic alkalosis. Renal retention of HCO_3^- (ie, low urine HCO_3^-), as occurs with severe vomiting and diuretic overuse, commonly contributes to metabolic alkalosis.

(Choice E) High pH with low PaCO_2 indicates respiratory alkalosis. Urine HCO_3^- may be low in the acute setting but begins to increase after several hours to provide metabolic compensation (full metabolic compensation requires approximately 72 hours). This patient at 31 weeks gestation will have fully compensated respiratory alkalosis with increased urine HCO_3^- excretion.

Educational objective:

The normal physiology of pregnancy involves chronic hyperventilation caused by elevated progesterone levels stimulating an increase in central respiratory drive. This creates an expected respiratory alkalosis with metabolic compensation (increased renal bicarbonate excretion) that helps facilitate the transport of acidic wastes from, and the transport of oxygen to, the developing fetus.





A newborn is being evaluated in the nursery. The patient was born at term via spontaneous vaginal delivery to a 23-year-old woman. The mother developed dark terminal facial hair and a deepened voice during the pregnancy. The delivery was unremarkable, and the patient's vital signs are within normal limits. Examination shows ambiguous genitalia and clitoromegaly. Laboratory studies reveal elevated serum levels of testosterone and androstenedione. Karyotype testing shows a 46,XX genotype. Ultrasound of the pelvis shows a normal-sized uterus. This infant's presentation is most likely due to deficiency of which of the following enzymes?

- ☐ A. 5-Alpha reductase
- ☐ B. 17-Alpha hydroxylase
- ☐ C. 21-Hydroxylase
- ☐ D. Aromatase
- ☐ E. HMG-CoA reductase

Submit



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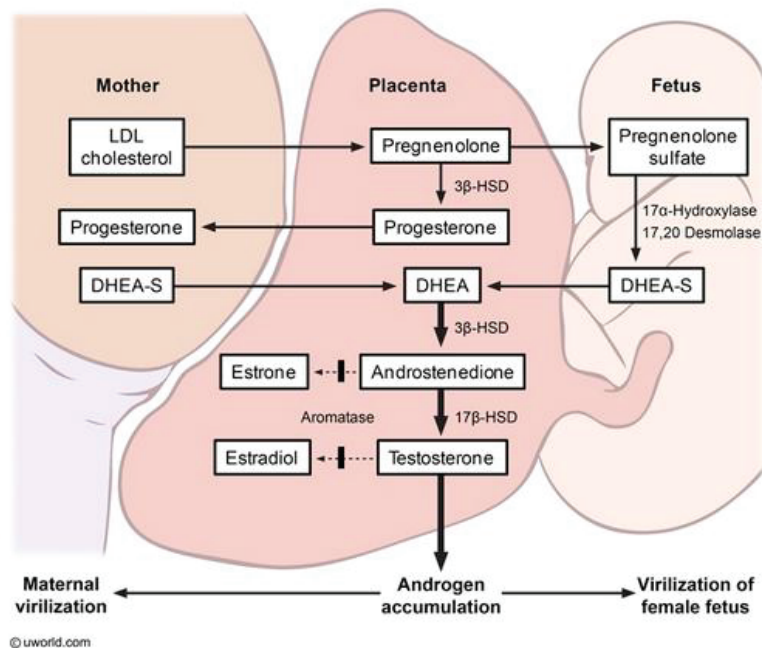
- ☐ A. 5-Alpha reductase (4%)
- ☐ B. 17-Alpha hydroxylase (7%)
- ☐ C. 21-Hydroxylase (42%)
- ☒ D. Aromatase (45%)
- ☐ E. HMG-CoA reductase (0%)





Exhibit Display

Fetal-placental aromatase deficiency



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This genotypically female (46,XX) infant with ambiguous genitalia was born to a mother who developed masculinizing features during pregnancy, findings which are consistent with aromatase deficiency.

Aromatase, a key enzyme in **estrogen synthesis**, normally converts androstenedione to estrone and testosterone to estradiol in various body tissues, including the gonads, adrenal glands, and adipose tissue. However, the majority of fetal estrogen is synthesized by aromatase within the placenta, which is genetically derived from the fetus.

Aromatase deficiency is an autosomal recessive disorder characterized by **high androgen** and **low estrogen** levels in the fetus and placenta. **Excess placental androgens** transfer into the maternal circulation, resulting in **maternal gestational virilization** (eg, acne, hirsutism, deep voice).

Newborn **girls** with aromatase deficiency have normal internal genitalia but **ambiguous external genitalia** (eg, clitoromegaly). At puberty, estrogen synthesis is impaired due to absent ovarian aromatase, which results in primary amenorrhea, osteoporosis, and tall stature due to delayed fusion of the epiphyses. Boys with aromatase deficiency have phenotypically normal genitalia but develop tall stature and osteoporosis as adults.

(Choice A) 5-Alpha reductase deficiency results in decreased synthesis of dihydrotestosterone, which is responsible for the development of external male genitalia (eg, scrotum, penis). Affected boys have





responsible for the development of external male genitalia (eg, scrotum, penis). Affected boys have underdeveloped genitalia, whereas girls are unaffected at birth.

(Choice B) 17-Alpha hydroxylase deficiency is a form of congenital adrenal hyperplasia. Symptoms result from decreased production of glucocorticoids and androgens (ambiguous genitalia in boys) and increased production of mineralocorticoids (hypertension, hypokalemia). Girls have phenotypically normal genitalia.

(Choice C) 21-Hydroxylase deficiency is the most common type of congenital adrenal hyperplasia and is associated with salt wasting and adrenal crises due to decreased aldosterone and cortisol synthesis. Increased androgen production causes ambiguous genitalia in girls, but maternal virilization does not occur due to intact placental aromatase activity (prevents androgens from entering the maternal circulation).

(Choice E) HMG-CoA reductase is the rate-limiting enzyme in the cholesterol synthesis pathway; statins inhibit this enzyme and reduce endogenous cholesterol synthesis. It is not involved in sexual differentiation.

Educational objective:

Aromatase is responsible for converting androgens into estrogens. Deficiency of this enzyme causes accumulation of androgens during pregnancy, resulting in ambiguous external genitalia in newborn girls and maternal gestational virilization.





A 3-week-old boy is brought to the emergency department due to lethargy for a day. The patient was breastfeeding well until this morning, when he became increasingly difficult to arouse. He was born full-term to a 35-year-old mother who had a spontaneous vaginal delivery at home. She took prenatal vitamins throughout pregnancy and received routine prenatal care. However, the boy did not receive any vaccinations or medications after birth due to parental preference for a "natural" newborn period. Family history is unremarkable. Head circumference is at the 99th percentile. Weight and length are at the 25th percentile. Physical examination shows a large, bulging anterior fontanel. The eyes appear driven downward and the patient is not able to track upward. No scalp swelling is present. Intracranial hemorrhage is confirmed on head CT scan. Which of the following is the most likely cause of this infant's condition?

- ☐ A. Abusive head trauma
- ☐ B. Bacterial meningitis
- ☒ C. Birth injury
- ☐ D. Germinal matrix fragility
- ☐ E. Impaired clotting factor carboxylation





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- ☐ A. Abusive head trauma (5%)
- ☐ B. Bacterial meningitis (19%)
- ☐ C. Birth injury (4%)
- ☐ D. Germinal matrix fragility (12%)
- ☒ E. Impaired clotting factor carboxylation (58%)

Correct

58%
Answered correctly52 secs
Time spent11/01/2020
Last Updated



Neonatal vitamin K deficiency

Etiology	<ul style="list-style-type: none">• Low vitamin K stores (poor placental transfer, sterile gut, low content in breast milk)• Inefficient vitamin K utilization by immature liver
Presentation	<ul style="list-style-type: none">• Intracranial, gastrointestinal, cutaneous, umbilical & surgical site bleeding
Prevention	<ul style="list-style-type: none">• Intramuscular vitamin K at birth

Vitamin K is an essential cofactor for gamma-glutamyl carboxylase, the enzyme responsible for converting glutamyl residues to gamma-carboxyglutamates. Carboxylation is critical for the function of clotting factors II (prothrombin), VII, IX, and X as it allows for the creation of calcium-binding sites. These sites attract the clotting factors to negatively charged phospholipids on platelets and endothelial cells, encouraging coagulation and thrombin formation.

Healthy children and adults rarely need exogenous vitamin K supplementation as endogenous colonic bacterial flora generates vitamin K and leafy-green vegetables are rich in vitamin K. In contrast, **newborns** have **low vitamin K stores** due to poor transplacental transfer and low content in breast milk. Insufficient levels remain in the first month of life due to delayed production by the gradual colonization of bacterial gut flora as well as insufficient utilization by an immature liver. Neonatal vitamin K deficiency is prevented by





have **low vitamin K stores** due to poor transplacental transfer and low content in breast milk. Insufficient levels remain in the first month of life due to delayed production by the gradual colonization of bacterial gut flora as well as insufficient utilization by an immature liver. Neonatal vitamin K deficiency is prevented by administration of intramuscular vitamin K at birth.

Without exogenous vitamin K, as in this patient, vitamin K deficiency results in **impaired clotting factor carboxylation** and, therefore, a propensity for bleeding. **Intracranial hemorrhage (ICH)** is a potentially fatal complication, often presenting with signs of **increased intracranial pressure** (eg, altered mental status, enlarging head circumference, bulging fontanel, downward-driven eyes).

(Choice A) Abusive head trauma can lead to intracranial bleeding and subdural hemorrhage in infants. This is less likely in an infant with no external trauma signs and no prior vitamin K prophylaxis. If the infant had received a vitamin K injection at birth, abusive head trauma would be the most likely diagnosis.

(Choice B) Neonatal bacterial meningitis can present with lethargy or irritability, but affected patients also have fever or hypothermia. In addition, bacterial meningitis does not typically cause ICH.

(Choice C) ICH from birth injuries is most common in operative deliveries involving vacuum or forceps assistance. Infants with birth injuries are typically symptomatic shortly after birth rather than at age 1 month.





(Choice B) Neonatal bacterial meningitis can present with lethargy or irritability, but affected patients also have fever or hypothermia. In addition, bacterial meningitis does not typically cause ICH.

(Choice C) ICH from birth injuries is most common in operative deliveries involving vacuum or forceps assistance. Infants with birth injuries are typically symptomatic shortly after birth rather than at age 1 month.

(Choice D) Germinal matrix fragility is responsible for intraventricular hemorrhage in premature infants. The germinal matrix starts involuting around 28 weeks gestation and disappears by full term.

Educational objective:

Vitamin K deficiency results in impaired clotting factor carboxylation. Newborns are at risk for vitamin K deficiency due to poor transplacental transfer of vitamin K and low content in breast milk. All newborns should receive vitamin K prophylaxis to prevent bleeding complications.

References

- Rise in late onset vitamin K deficiency bleeding in young infants because of omission or refusal of prophylaxis at birth.
- Vitamin K deficiency bleeding: a case study.





A 26-year-old woman, gravida 1 para 0, at 36 weeks gestation comes to the office for a routine prenatal visit. She has had no headaches, changes in vision, or right upper quadrant pain. Fetal movement is normal. The patient has no chronic medical conditions, and her pregnancy has been uncomplicated. Blood pressure today is 150/100 mm Hg, and a repeat measurement is 154/102 mm Hg. All other vital signs are normal. Urinalysis shows 2+ protein. This patient's condition is most likely due to decreased activity of which of the following?

- ☐ A. Endothelin
- ☐ B. Human chorionic gonadotropin
- ☐ C. Prolactin
- ☐ D. Thromboxane A₂
- ☐ E. Vascular endothelial growth factor

Submit



A 26-year-old woman, gravida 1 para 0, at 36 weeks gestation comes to the office for a routine prenatal visit. She has had no headaches, changes in vision, or right upper quadrant pain. Fetal movement is normal. The patient has no chronic medical conditions, and her pregnancy has been uncomplicated. **Blood pressure** today is 150/100 mm Hg, and a repeat measurement is 154/102 mm Hg. All other vital signs are normal. Urinalysis shows 2+ protein. This patient's condition is most likely due to decreased activity of which of the following?

- ☒ A. Endothelin (33%)
- ☐ B. Human chorionic gonadotropin (8%)
- ☐ C. Prolactin (2%)
- ☐ D. Thromboxane A₂ (13%)
- ☒ E. Vascular endothelial growth factor (42%)

Incorrect

Correct answer

E



42%

Answered correctly



01 min, 21 secs

Time Spent



09/15/2020

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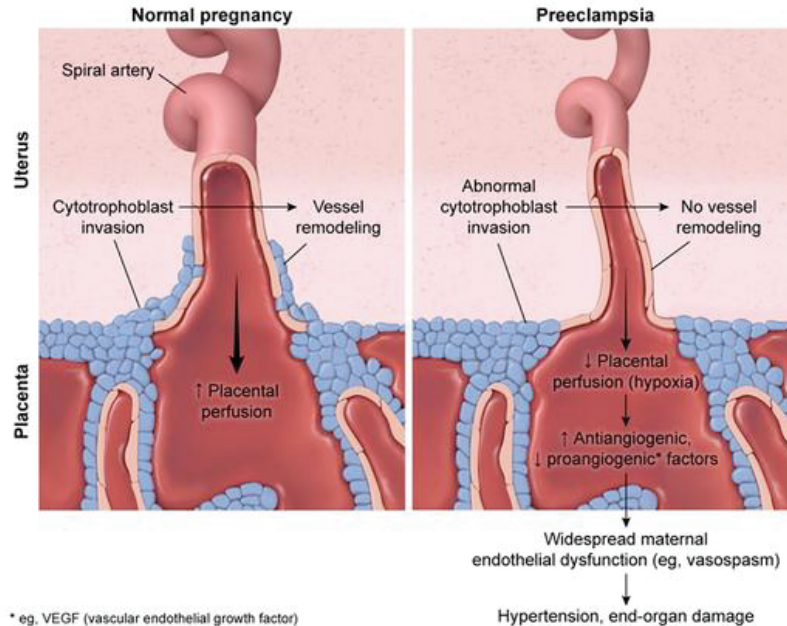
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Pathogenesis of preeclampsia



* eg, VEGF (vascular endothelial growth factor)
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This patient has **preeclampsia**, which is defined as new onset **hypertension** during pregnancy (systolic ≥ 140 mm Hg or diastolic ≥ 90 mm Hg) with **proteinuria** and/or signs of end-organ damage (eg, headache, renal insufficiency). Although patients typically develop symptoms in the third trimester, the disease process usually begins during the first trimester with abnormal placental development.

In patients who develop preeclampsia, early cytotrophoblast invasion is abnormal; as a result, the maternal spiral arteries that supply blood to the fetoplacental unit are abnormally underdeveloped and become high resistance, low perfusion vessels. This decrease in perfusion leads to **chronic placental ischemia**, which triggers increased **release of antiangiogenic factors** throughout the maternal circulation. These antiangiogenic factors bind and **decrease proangiogenic factors** such as **vascular endothelial growth factor** (VEGF) and placental growth factor.

The overall effect is inhibited angiogenesis and widespread maternal **endothelial cell dysfunction**, resulting in dysregulated vascular tone (eg, vasospasm, hypertension), abnormally increased vascular permeability (eg, proteinuria), and decreased end-organ perfusion (eg, renal insufficiency).

(Choices A and D) Endothelin and thromboxane A₂ (TXA₂) are potent vasoconstrictors. Therefore, their activity is typically increased, not decreased, in preeclampsia due to increased endothelin and TXA₂





(Choices A and D) Endothelin and thromboxane A2 (TXA2) are potent vasoconstrictors. Therefore, their activity is typically increased, not decreased, in preeclampsia due to increased endothelin and TXA2 production by dysfunctional endothelial cells.

(Choices B and C) Decreased human chorionic gonadotropin and prolactin levels are associated with first-trimester pregnancy loss (ie, spontaneous abortion); however, activity levels of neither hormone are related to preeclampsia.

Educational objective:

Preeclampsia is new-onset hypertension (systolic ≥ 140 mm Hg or diastolic ≥ 90 mm Hg) with proteinuria and/or signs of end-organ damage (eg, renal insufficiency). Preeclampsia is associated with widespread maternal endothelial dysfunction, which occurs due to increased antiangiogenic factor release and decreased proangiogenic factor activity (eg, vascular endothelial growth factor).

References

- [Mechanisms of endothelial dysfunction in hypertensive pregnancy and preeclampsia.](#)

Pathophysiology

Subject

Pregnancy, Childbirth & Puerperium

System

Preeclampsia

Topic





A 35-year-old woman, gravida 1 para 0, comes to the office for an initial prenatal visit. The patient has had no vaginal bleeding or abdominal pain and has not yet felt fetal movement. Menarche occurred at age 13. She sometimes has heavy menstrual bleeding with passage of clots, and other times she skips her menses. The patient's estimated gestational age based on her last menstrual period is 16 weeks. She has type 1 diabetes mellitus that is controlled with insulin. She smokes a pack of cigarettes daily. As part of her prenatal laboratory screening, a second-trimester maternal serum quadruple screen is performed and reveals an elevated alpha-fetoprotein level. Which of the following is the most likely etiology of this patient's abnormal screening result?

- ☐ A. Dating error
- ☐ B. Down syndrome
- ☐ C. Edwards syndrome
- ☐ D. Fetal growth restriction
- ☐ E. Fetal heart defect
- ☐ F. Hydatidiform mole





no vaginal bleeding or abdominal pain and has not yet felt fetal movement. Menarche occurred at age 13.

She sometimes has heavy menstrual bleeding with passage of clots, and other times she skips her menses. The patient's estimated gestational age based on her last menstrual period is 16 weeks. She has type 1 diabetes mellitus that is controlled with insulin. She smokes a pack of cigarettes daily. As part of her prenatal laboratory screening, a second-trimester maternal serum quadruple screen is performed and reveals an elevated alpha-fetoprotein level. Which of the following is the most likely etiology of this patient's abnormal screening result?



- ☒ A. Dating error (39%)
- ☐ B. Down syndrome (28%)
- ☐ C. Edwards syndrome (7%)
- ☐ D. Fetal growth restriction (10%)
- ☐ E. Fetal heart defect (4%)
- ☐ F. Hydatidiform mole (9%)





Maternal serum alpha-fetoprotein screening

↑ MSAFP

- Open neural tube defects (eg, anencephaly, open spina bifida)
- Ventral wall defects (eg, omphalocele, gastroschisis)
- Multiple gestation

↓ MSAFP

- Aneuploidies (eg, trisomy 18 & 21)

MSAFP = maternal serum alpha-fetoprotein.

The **maternal serum quadruple screen** is used to identify pregnancies at risk for **congenital defects** or **fetal aneuploidy** (eg, Down syndrome). It measures the concentration of **alpha-fetoprotein (AFP)**, estriol, β -hCG, and inhibin A in the maternal blood.

AFP is a glycoprotein produced in the fetal liver and gastrointestinal tract. Levels are **dependent on gestational age** and maternal conditions such as diabetes mellitus (typically associated with decreased MSAFP and estriol levels). Therefore, accurate pregnancy dating and complete medical history are





AFP is a glycoprotein produced in the fetal liver and gastrointestinal tract. Levels are **dependent on gestational age** and maternal conditions such as diabetes mellitus (typically associated with decreased MSAFP and estriol levels). Therefore, accurate pregnancy dating and complete medical history are required to correctly interpret an AFP level.

The most common cause of an **abnormal AFP level** is inaccurate pregnancy dating (ie, **dating error**). In patients with irregular menses, dating by a last menstrual period can underestimate the true gestational age. Therefore, these patients require a fetal ultrasound, which can accurately determine gestational age and evaluate for other common causes of elevated MSAFP levels, which include multiple gestation (eg, twin pregnancy), open neural tube defects, and abdominal wall defects.

(Choices B and C) Down syndrome (trisomy 21) and **Edwards syndrome** (trisomy 18) are associated with low AFP levels.

(Choice D) Fetal growth restriction can occur due to tobacco use, which causes placental ischemia and resultant placental insufficiency. However, maternal serum quadruple screen shows decreased estriol levels, not increased AFP levels, with fetal growth restriction.

(Choice E) Although the risk for fetal heart defects is increased with maternal diabetes mellitus, heart defects are not associated with abnormal AFP levels because AFP is not produced in fetal cardiac tissue.





(Choices B and C) Down syndrome (anomaly 21) and Edwards syndrome (anomaly 18) are associated with

low AFP levels.

(Choice D) Fetal growth restriction can occur due to tobacco use, which causes placental ischemia and resultant placental insufficiency. However, maternal serum quadruple screen shows decreased estriol levels, not increased AFP levels, with fetal growth restriction.

(Choice E) Although the risk for fetal heart defects is increased with maternal diabetes mellitus, heart defects are not associated with abnormal AFP levels because AFP is not produced in fetal cardiac tissue.

(Choice F) Hydatidiform moles and other gestational trophoblastic diseases typically present with markedly elevated β -hCG levels, not elevated AFP levels. Patients may have vaginal bleeding and a significantly enlarged uterus.

Educational objective:

The maternal serum quadruple screen assesses for risk of congenital defects and fetal aneuploidy and includes measurement of alpha-fetoprotein levels, which are dependent on gestational age. An abnormal alpha-fetoprotein level is most commonly due to a dating error (eg, inaccurate gestational age).

References

- Prenatal diagnosis: screening and diagnostic tools.





A 31-year-old woman, gravida 2 para 1, at 30 weeks gestation comes to the emergency department due to increased swelling in her face and lower extremities. She has noticed a sudden onset of swelling and a 2.72-kg (6-lb) weight gain in the last day. The patient has not urinated in the last 12 hours despite an increase in fluid intake. She has a twin pregnancy and no chronic medical conditions. Blood pressure is 154/98 mm Hg, and pulse is 98/min. Bladder catheterization yields a total of 10 mL of dark urine. Urinalysis shows no red blood cells. Which of the following pathologic factors is the most likely cause of this patient's decreased urine output?

- ☐ A. Inflammation of the glomeruli
- ☐ B. Immune complex deposition within glomeruli
- ☐ C. Inflammation of the renal interstitium
- ☐ D. Obstructing stone within the renal calyx
- ☐ E. Vasospasm of the intrarenal arteries

Submit



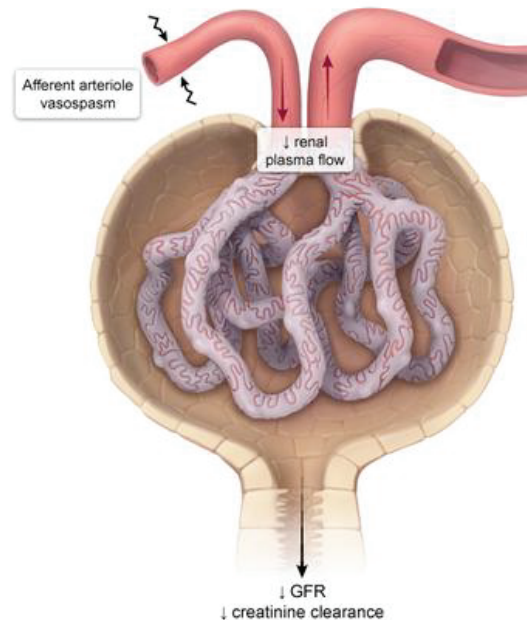
A 31-year-old woman, gravida 2 para 1, at 30 weeks gestation comes to the emergency department due to increased swelling in her face and lower extremities. She has noticed a sudden onset of swelling and a 2.72-kg (6-lb) weight gain in the last day. The patient has not urinated in the last 12 hours despite an increase in fluid intake. She has a twin pregnancy and no chronic medical conditions. Blood pressure is 154/98 mm Hg, and pulse is 98/min. Bladder catheterization yields a total of 10 mL of dark urine. Urinalysis shows no red blood cells. Which of the following pathologic factors is the most likely cause of this patient's decreased urine output?

- ☐ A. Inflammation of the glomeruli (12%)
- ☐ B. Immune complex deposition within glomeruli (13%)
- ☐ C. Inflammation of the renal interstitium (12%)
- ☐ D. Obstructing stone within the renal calyx (13%)
- ☒ E. Vasospasm of the intrarenal arteries (47%)



Exhibit Display

Intrarenal artery vasospasm



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This patient at 30 weeks gestation has **oliguria**, or decreased urine output (<500 mL/24 hr), likely due to preeclampsia. **Preeclampsia** is defined as **new-onset hypertension** (systolic ≥ 140 mm Hg or diastolic ≥ 90 mm Hg) at ≥ 20 weeks gestation plus proteinuria and/or signs of **end-organ dysfunction** (eg, renal failure). Preeclampsia is thought to be caused by abnormal placentation and poorly developed uterine spiral arteries, which lead to **placental ischemia**. Twin gestations are at increased risk, likely due to increased placental mass.

In preeclampsia, the ischemic placenta releases **antiangiogenic factors** that cause widespread **maternal endothelial cell damage**. The resulting **capillary leakage** is responsible for third spacing of fluid (eg, facial edema, weight gain) and leakage of protein into the urine (ie, proteinuria). In addition, disrupted endothelial control of vascular tone causes hypertension and **widespread vasospasm**, resulting in end-organ hypoperfusion. In the kidneys, vasospasm causes decreased renal blood flow and glomerular filtration rate, leading to **minimal, concentrated urine** (ie, high specific gravity) and increased serum creatinine levels.

Gradual recovery of renal function typically occurs following delivery of the placenta, which is curative for preeclampsia.

(Choices A and B) Inflammation of the glomeruli (ie, glomerulonephritis) can occur as a result of





(Choices A and B) Inflammation of the glomeruli (ie, glomerulonephritis) can occur as a result of glomerular immune complex deposition, such as with anti-glomerular basement membrane (Goodpasture) disease (ie, basement membrane IgG deposits) and IgA nephropathy (ie, mesangial IgA deposits). Although these conditions can cause nephritic syndrome (eg, hypertension, mild to moderate proteinuria and edema, oliguria), red blood cells and casts would be expected on urinalysis.

(Choice C) Inflammation of the renal interstitium (eg, acute interstitial nephritis) can cause oliguria but is typically drug related (eg, nonsteroidal anti-inflammatory drugs, beta-lactam antibiotics) and associated with rash and fever, which are not seen in this patient.

(Choice D) A stone within the renal calyx (eg, staghorn calculus) may decrease the urine output of the affected kidney due to obstruction; however, overall urine output is typically preserved due to normal functioning of the contralateral kidney. In addition, renal stones typically cause hematuria.

Educational objective:

Preeclampsia is new-onset hypertension at ≥ 20 weeks gestation plus proteinuria and/or signs of end-organ damage. Preeclampsia is caused by widespread maternal endothelial cell damage due to release of antiangiogenic factors from an ischemic placenta. The result is widespread capillary leakage (proteinuria, edema) and vasospasm (hypertension, end-organ hypoperfusion [eg, renal failure]).





A 28-year-old woman, gravida 2 para 2, comes to the office with worsening shortness of breath over the past week. She had a recent episode of hemoptysis. The patient has also had ongoing vaginal bleeding after an uncomplicated vaginal delivery of her son 9 weeks ago. She has no bleeding elsewhere, and she has not resumed sexual intercourse. On physical examination, the patient's uterus is enlarged and the adnexa are normal. Laboratory studies show markedly increased β -hCG levels. Chest radiograph shows multiple bilateral lung nodules. Which of the following would most likely be found on endometrial curettage in this patient?

- ☐ A. Bundles of smooth muscle cells with fibrosis
- ☐ B. Diffusely hydropic chorionic villi
- ☐ C. Fetal tissue with triploid karyotype
- ☐ D. Glands lined by atypical columnar epithelial cells
- ☐ E. Proliferation of cytotrophoblasts and syncytiotrophoblasts

Submit



A 28-year-old woman, gravida 2 para 2, comes to the office with worsening shortness of breath over the past week. She had a recent episode of **hemoptysis**. The patient has also had ongoing vaginal bleeding after an uncomplicated vaginal delivery of her son 9 weeks ago. She has no bleeding elsewhere, and she has not resumed sexual intercourse. On physical examination, the patient's uterus is enlarged and the adnexa are normal. Laboratory studies show markedly **increased** β -hCG levels. Chest radiograph shows multiple bilateral lung nodules. Which of the following would most likely be found on endometrial curettage in this patient?

- ☐ A. ~~Bundles of smooth muscle cells with fibrosis (2%)~~
- ☐ B. Diffusely hydropic chorionic villi (20%)
- ☐ C. ~~Fetal tissue with triploid karyotype (4%)~~
- ☐ D. Glands lined by atypical columnar epithelial cells (6%)
- ☒ E. Proliferation of cytotrophoblasts and syncytiotrophoblasts (65%)





Histology of gestational trophoblastic disease

Diagnosis	Classification	Trophoblasts	Villi	Fetal/ embryonic tissue
Partial mole	Benign	Focally hyperplastic	Focally enlarged, hydropic	Present, triploid
Complete mole	Benign	Diffusely hyperplastic	Diffusely enlarged, hydropic	Absent
Invasive mole	Malignant	Diffusely hyperplastic with myometrial invasion	Diffusely enlarged, hydropic	Absent
Gestational choriocarcinoma	Malignant	Diffusely anaplastic/ necrotic with	Absent	Present or absent



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Gestational choriocarcinoma	Malignant	Diffusely anaplastic/ necrotic with vascular invasion	Absent	Present or absent

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Gestational choriocarcinoma is a **malignant** tumor that arises from the **trophoblast**. It is most commonly preceded by a normal pregnancy but can occur following any pregnancy (molar, ectopic, aborted). The tumor causes abnormal **vaginal bleeding**, uterine enlargement, and **significantly increased β -hCG levels**.



Gestational choriocarcinoma is a **malignant** tumor that arises from the **trophoblast**. It is most commonly preceded by a normal pregnancy but can occur following any pregnancy (molar, ectopic, aborted). The tumor causes abnormal **vaginal bleeding**, uterine enlargement, and **significantly increased β -hCG levels**.

Choriocarcinoma is aggressive and rapidly invades the uterine wall with **hematogenous** spread thereafter. The **lungs** are the most common site of distal metastasis, and presenting symptoms can include shortness of breath and hemoptysis. On macroscopic examination, gestational choriocarcinoma is seen as a bulky intrauterine mass that is usually soft and yellow-white, with extensive areas of necrosis and hemorrhage. Histologically, it is composed of abnormal proliferation of mononuclear **cytotrophoblasts** (red arrows) and multinuclear **syncytiotrophoblasts** (green arrows). No villi are present.

(Choice A) Myomas (eg, uterine fibroids) are common benign tumors of the uterine myometrium characterized by bundles of smooth muscle cells. Common symptoms include menstrual irregularities and pelvic pressure/pain.

(Choice B) Cells of the evacuated tissue of a complete mole have a 46,XX (or rarely 46,XY) karyotype containing only paternal DNA. Histologically, no fetal tissue is present, and only edematous (eg, hydropic)





Item 8 of 9

Question Id: 335



Mark



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Lab Values



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Calculator



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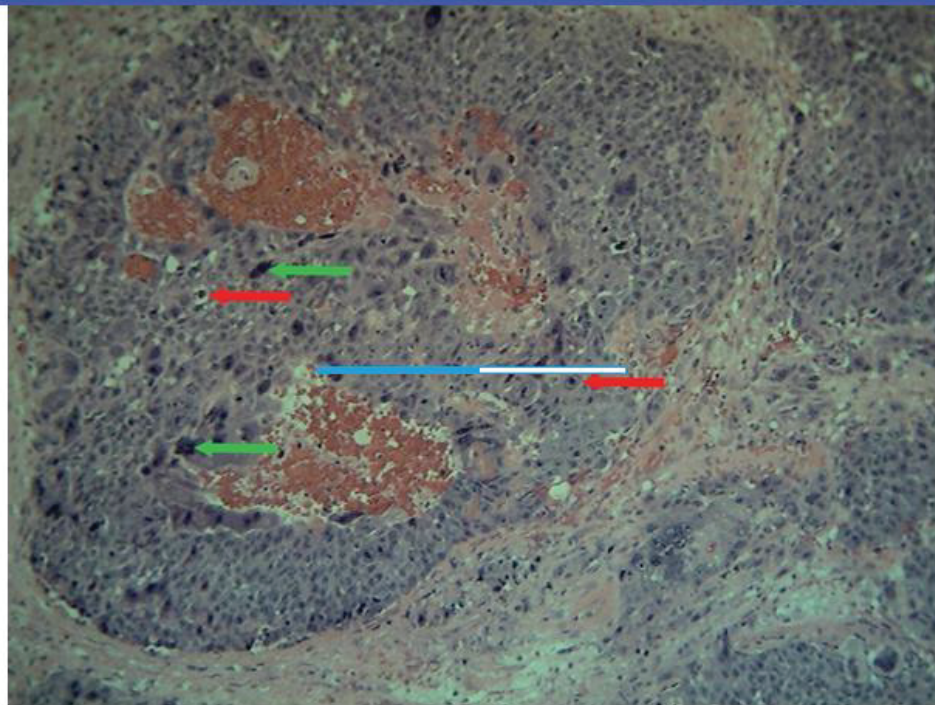


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(Choice A) Myomas (eg, uterine fibroids) are common benign tumors of the uterine myometrium

characterized by bundles of smooth muscle cells. Common symptoms include menstrual irregularities and pelvic pressure/pain.

(Choice B) Cells of the evacuated tissue of a complete mole have a 46,XX (or rarely 46,XY) karyotype containing only paternal DNA. Histologically, no fetal tissue is present, and only edematous (eg, hydropic) villi are seen.

(Choice C) Partial hydatidiform moles typically have a triploid karyotype (69,XXX or 69,XXY) containing maternal and paternal DNA, with an extra chromosome set of paternal origin. Evacuated uterine contents contain fetal tissue and other parts (eg, cord, amniotic membrane), some edematous villi with focal trophoblastic proliferation, and normal-appearing villi.

(Choice D) The normal endometrium consists of simple columnar epithelial cells. Endometrial hyperplasia characterized by crowded endometrial glands lined by atypical cells (nuclear atypia) is an important risk factor for endometrial cancer. Endometrial hyperplasia is associated with prolonged exposure to high estrogen levels (eg, obesity, nulliparity, tamoxifen use) and can present as abnormal vaginal bleeding in a postmenopausal woman.

Educational objective:

Choriocarcinoma is a malignant form of gestational trophoblastic disease composed of syncytiotrophoblastic





(Choice C) Partial hydatidiform moles typically have a triploid karyotype (69,XXX or 69,XXY) containing maternal and paternal DNA, with an extra chromosome set of paternal origin. Evacuated uterine contents contain fetal tissue and other parts (eg, cord, amniotic membrane), some edematous villi with focal trophoblastic proliferation, and normal-appearing villi.

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Educational objective:

Choriocarcinoma is a malignant form of gestational trophoblastic disease composed of anaplastic cytotrophoblasts and syncytiotrophoblasts without villi. It often presents as dyspnea/hemoptysis due to pulmonary metastasis from hematogenous spread.

References

- Gestational trophoblastic disorders: an update in 2015.
- Practice bulletin no. 53--diagnosis and treatment of gestational trophoblastic disease.





A newborn boy is in the neonatal intensive care unit for mechanical ventilation due to pulmonary hypoplasia. He was born vaginally to a 41-year-old woman who did not establish prenatal care until 30 weeks gestation. The mother had assumed her lack of periods was due to early menopause, which runs in her family. She took many different medications for her poorly controlled hypertension over the past year before realizing she was pregnant. Prenatal ultrasonography demonstrated severe oligohydramnios for which delivery was induced. Examination of the infant shows an intubated and sedated boy with weight at the 3rd percentile. His temporal, occipital, and parietal bones are underdeveloped, and his right lower limb is shortened and contracted. Which of the following is the most likely cause of this neonate's abnormalities?

- ☐ A. Alpha 2-adrenergic agonism
- ☐ B. Beta-adrenergic receptor blockade
- ☐ C. Cellular damage from free radicals
- ☐ D. Impaired metabolism of angiotensin I
- ☐ E. Impaired oxygen delivery





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- ☐ F. Impaired prostaglandin metabolism





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- ☐ A. Alpha 2-adrenergic agonism (2%)
- ☐ B. Beta-adrenergic receptor blockade (8%)
- ☐ C. Cellular damage from free radicals (6%)
- ☒ D. Impaired metabolism of angiotensin I (60%)
- ☐ E. Impaired oxygen delivery (14%)
- ☐ F. Impaired prostaglandin metabolism (8%)

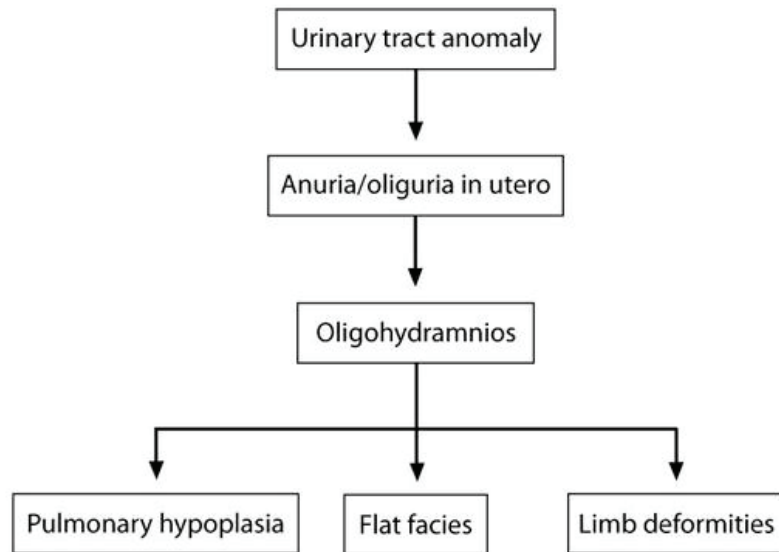
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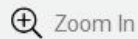


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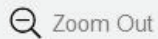
Potter sequence



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The constellation of findings in this neonate is likely due to maternal use of angiotensin-converting enzyme **(ACE) inhibitors** and/or angiotensin II receptor blockers **(ARBs)** during pregnancy for antihypertensive therapy. Angiotensin II is required for normal renal development. ACE inhibitors prevent the conversion of angiotensin I to II, whereas ARBs block the action of angiotensin II at the AT1 receptor.

Fetal urine is a major source of amniotic fluid, a liquid that surrounds and cushions the fetus and permits normal lung development. **Low angiotensin II** levels can result in fetal renal maldevelopment, which in turn leads to reduced diuresis and **oligohydramnios**. Severe oligohydramnios can result in pulmonary hypoplasia and skeletal defects. In addition, low angiotensin II levels may result in impaired cranial vascularization and **hypocalvaria** (hypoplasia of skull bones).

(Choices A and B) Methyldopa, an alpha 2-adrenergic agonist, and labetalol, a beta-adrenergic antagonist, are first-line antihypertensive medications in pregnancy. Although labetalol can cause fetal/neonatal bradycardia, hypoglycemia, and hypotension, neither medication causes congenital malformations. Instead, fetal outcomes are improved by reducing maternal hypertension and its associated adverse effects.

(Choice C) Prenatal radiation exposure leads to cellular damage due to molecular bond disruption by free





(Choice C) Prenatal radiation exposure leads to cellular damage due to molecular bond disruption by free radicals. Fetuses exposed to radiation are at risk for cancer, particularly childhood leukemia.

(Choice E) Tobacco impairs oxygen delivery to fetal tissue and leads to multiple pregnancy complications, most notably intrauterine growth restriction and preterm delivery. Oligohydramnios and its fetal sequelae are not typically due to tobacco use.

(Choice F) Nonsteroidal anti-inflammatory drugs (NSAIDs) decrease the production of prostaglandin E1 and are avoided in the third trimester of pregnancy due to potential for premature closure of the ductus arteriosus. NSAIDs are not used to treat hypertension.

Educational objective:

Fetopathy due to angiotensin-converting enzyme inhibitors or angiotensin II receptor blockers results from blockade of angiotensin II, which is necessary for normal renal development. Use of these antihypertensive drugs during pregnancy can result in fetal anuria, oligohydramnios, pulmonary hypoplasia, limb contractures, and calvarium defects.

References

- [Potter's sequence.](#)





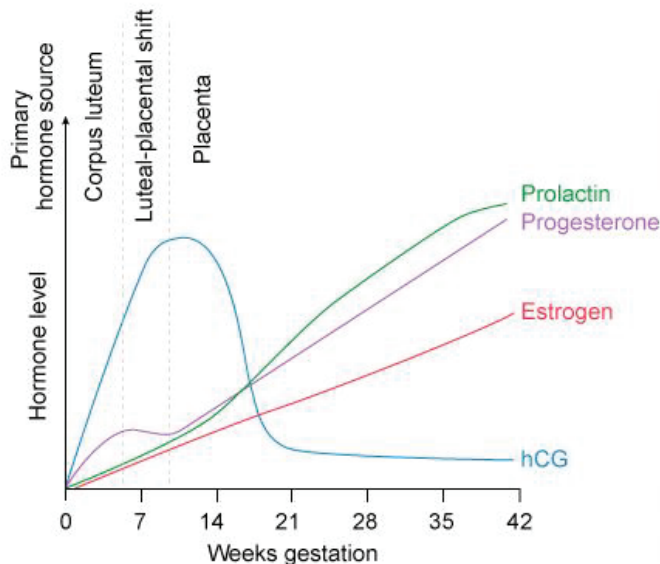
A 25-year-old woman comes to the office due to amenorrhea. The patient's last menstrual period was 8 weeks ago, and she normally has regular, monthly menses. The patient has no chronic medical conditions and has had no surgeries. She takes no daily medications. Blood pressure is 100/60 mm Hg and pulse is 92/min. BMI is 24 kg/m². Abdominal examination shows a soft, nontender abdomen with no palpable masses. Pelvic examination shows an 8-week-sized, nontender uterus. Serum β -hCG level is elevated. Which of the following is the most important direct role of hCG in this patient?

- ☐ A. Induction of prolactin production by the pituitary
- ☐ B. Inhibition of uterine contractions
- ☐ C. Initiation of embryonic cell division and differentiation
- ☐ D. Maintenance of the corpus luteum
- ☐ E. Promotion and maintenance of embryonic implantation

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Hormonal changes in pregnancy



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Early pregnancy depends on hormonal feedback between the ovary, uterine endometrium, and embryo. In a normal **menstrual cycle**, ovulation (ie, oocyte release) creates the **ovarian corpus luteum**, which increases **progesterone production** to induce endometrial decidualization (ie, uterine lining thickening,





Weeks gestation

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Early pregnancy depends on hormonal feedback between the ovary, uterine endometrium, and embryo. In a normal **menstrual cycle**, ovulation (ie, oocyte release) creates the **ovarian corpus luteum**, which increases **progesterone production** to induce endometrial decidualization (ie, uterine lining thickening, formation of the decidua basalis) in preparation for both promotion and maintenance of embryonic implantation **(Choice E)**.

When the oocyte is fertilized, a blastocyst eventually develops and implants into the uterine decidua basalis approximately 6-7 days after fertilization. The outer cells of the blastocyst (ie, trophoblast) then differentiate into the **cytotrophoblast and syncytiotrophoblast**, which develop into the placenta.

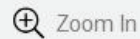
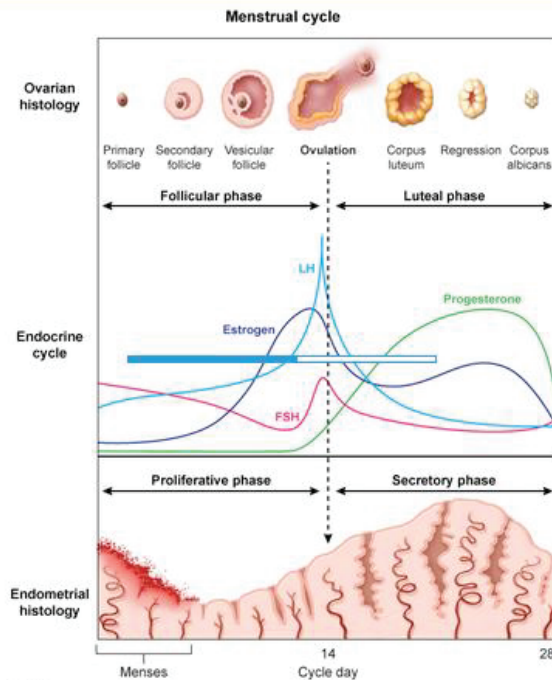
The **syncytiotrophoblast** invades the decidua basalis and **secretes β -hCG** into maternal circulation. β -hCG signals the ovary to **maintain the corpus luteum** and to continue progesterone production, which maintains both the decidualized endometrium and the pregnancy until the placenta has developed enough to completely take over progesterone production (typically by 10 weeks gestation). Following this **luteal-placental transition**, the corpus luteum degenerates, and the role of progesterone changes to maintain uterine quiescence (ie, inhibit contractions) **(Choice B)**.

(Choice A) Estrogen, not hCG, stimulates the anterior pituitary to produce prolactin during pregnancy.

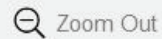




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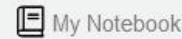
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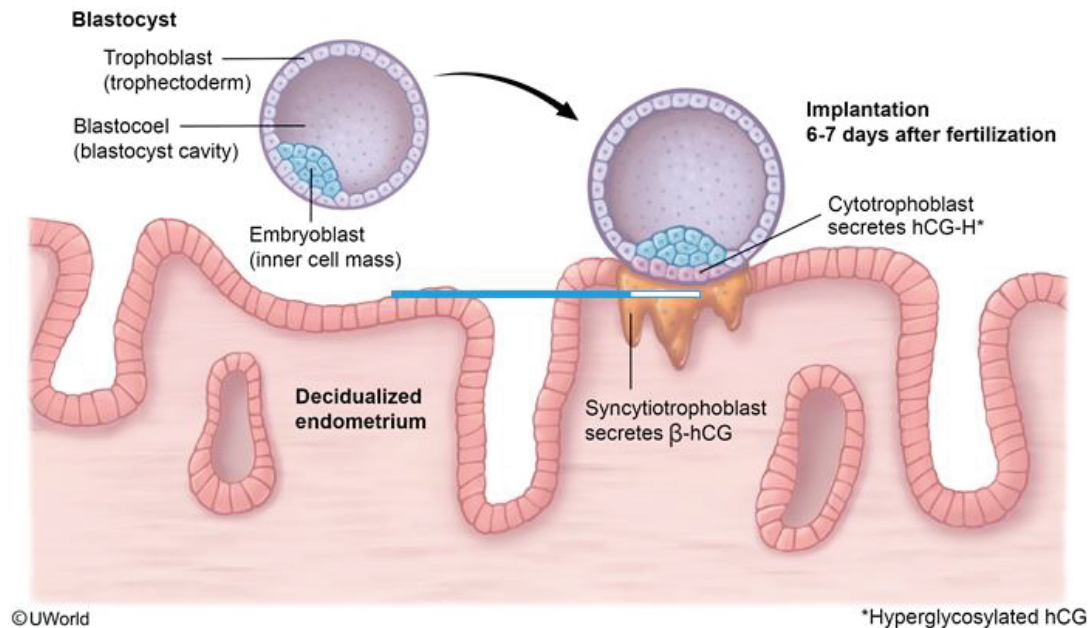
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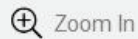


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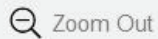
Blastocyst implantation



*Hyperglycosylated hCG



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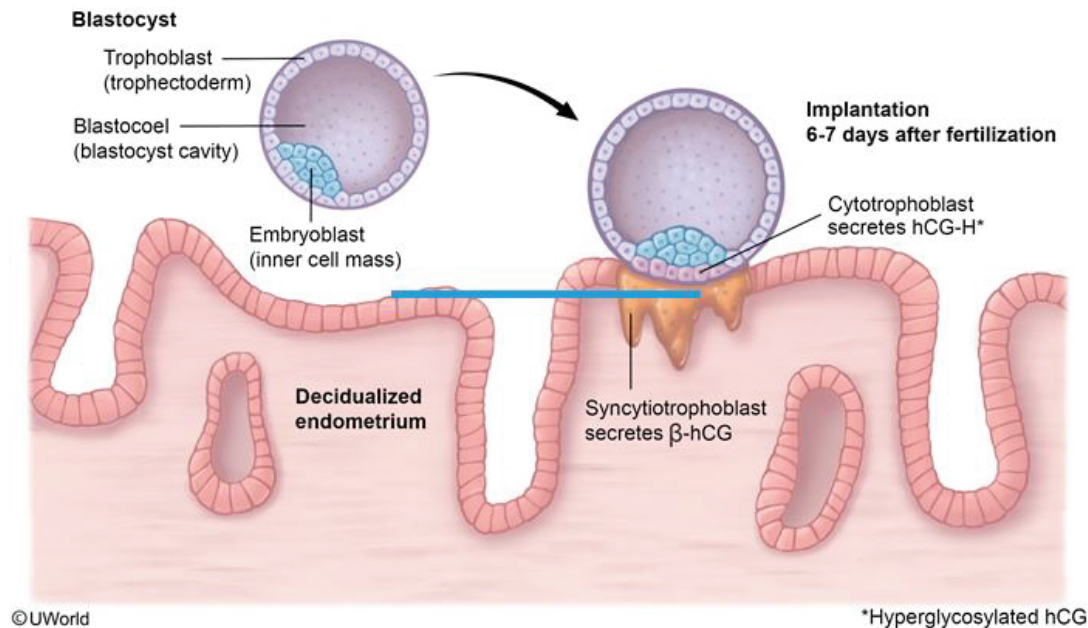
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Blastocyst implantation



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(Choice A) Estrogen, not hCG, stimulates the anterior pituitary to produce prolactin during pregnancy.

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(Choice A) Estrogen, not hCG, stimulates the anterior pituitary to produce prolactin during pregnancy.

(Choice C) The process of **embryonic cell division** and differentiation begins before the formation of the placental syncytiotrophoblast, which secretes hCG; therefore, hCG does not cause embryonic cell division.

Educational objective:

β -hCG is a hormone secreted by the placental syncytiotrophoblast after uterine invasion that signals the ovary to maintain the corpus luteum, which produces progesterone in early pregnancy.

References

- [hCG: biological functions and clinical applications.](#)

Pathophysiology

Subject

Pregnancy, Childbirth & Puerperium

System

Normal pregnancy

Topic

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